ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. 34. No. 26. WEEKLY. | NEW YORK, WEDNESDAY, JUNE 28, 1899. | $3 PER ANNUM. SINGLE COPIES, 10 CENTS.

Copyright, 1899, by ELECTRICAL REVIEW PUBLISHING COMPANY, Times Building, 41 Park Row, New York.

Entered at the Post Office, New York, as Mail Matter of the Second Class.

TELEPHONE CONVENTION IN CHICAGO.

Highly Successful Gathering of Representatives of the Independent Telephone Field.

ATTENDANCE MUCH GREATER THAN EXPECTED, NEARLY 400 EXCHANGE REPRESENTATIVES BEING PRESENT AND A LARGE NUMBER OF MANUFACTURERS—THE MEETING IS EXPECTED TO PROVE OF GREAT BENEFIT TO THE INDEPENDENT TELEPHONE INTERESTS THROUGHOUT THE ENTIRE COUNTRY, OVER 20 STATES BEING REPRESENTED—INTERESTING ADDRESS BY PRESIDENT THOMAS—PROCEEDINGS IN GENERAL.

CHICAGO, June 28—The convention of the Independent Telephone Association of the United States of America, which has just concluded its work in this city, was attended by some 350 telephone exchange men and the largest representation of manufacturers in that field ever assembled in one city. The meetings were held at the Auditorium Hotel, where Manager Kennedy saw that every convenience and comfort were provided.

It is safe to say that the work of the meeting will undoubtedly be of great benefit to the independent telephone interests throughout the country, and through them to the vast and rapidly increasing public that is becoming acquainted with the advantages and facilities provided in many instances by the independent exchanges only. Some 23 states were represented by delegates to the convention.

When the meeting was called to order at 10 o'clock on Tuesday, June 27, and the reading of the president's message begun, a particularly wide-awake and energetic-appearing

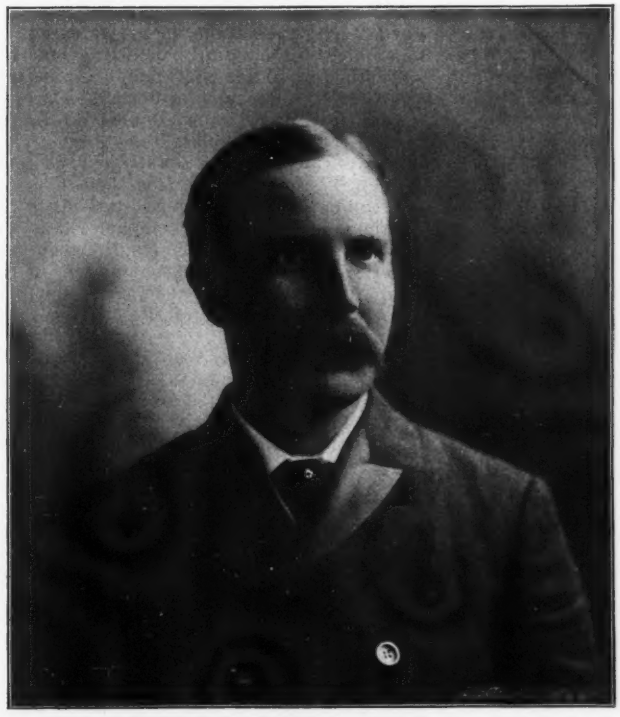
(Continued on page 410.)

Dr. Arthur Edwin Kennelly.

The president of the American Institute of Electrical Engineers, Dr. Arthur E. Kennelly, was born in Bombay, India, in the latter part of the year 1861. His education was received at the University College School in London, and upon its completion, at the early age of 16 years, he entered the service of the Society of Telegraph Engineers as assistant secretary. In 1878 he became a clerk for the Eastern Telegraph Company, serving at Porthcurnow and Malta. Placed, in 1880, as assistant electrician aboard the cable steamship "Great Northern," he rose to be, in 1882, chief electrician of the cableship "John Pender," and subsequently acted in the same capacity aboard the "Chiltern." "Retriever" and "Electro" in the Mediterranean and Red seas, the Indian Ocean and the Atlantic. For a paper on a new method of localizing faults in submarine cables he received the premium of the British Institution of Electrical Engineers, the Fahie premium of the same institution falling to his lot in 1889.

In 1888 he resigned his position as senior electrician of the ship staff of the Eastern Telegraph Company, and, coming to America, became electrician in the Edison laboratory at Orange, N. J. In 1894 he became associated with Prof. E. J. Houston, of Philadelphia, and has since practised as a consulting electrical engineer.

Nine years ago the Western University of Pennsylvania conferred upon Dr. Kennelly the honorary degree of Doctor of Science for electrical research. He has since been elected president of the American Institute of Electrical Engineers, and is a member of various scientific societies, including the London Institution of Electrical Engineers.



DR. ARTHUR EDWIN KENNELLY, PRESIDENT OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE INSTITUTE MEETING.

Sixteenth General Meeting of the American Institute of Electrical Engineers at Boston.

PROCEEDINGS, PAPERS AND DISCUSSIONS AT THE MEETING IN THE WALKER BUILDING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON, JUNE 26, 27 AND 28, 1899.

The sixteenth general meeting of the American Institute of Electrical Engineers opened most auspiciously at 10.30 A. M., Monday, June 26, in one of the large lecture-rooms of the Massachusetts Institute of Technology, Boston, with a large attendance and a programme of unusual interest. Agreeable headquarters had been provided in the Brunswick Hotel, immediately across Boylston street from the meeting hall, and beautiful weather added no little to the pleasure of the occasion.

MONDAY, JUNE 26.

The meeting was called to order by the president, Dr. Arthur E. Kennelly, who introduced the Hon. Josiah Quincy, Mayor of Boston. Mayor Quincy welcomed the Institute to his city with exceedingly felicitous remarks. He said, in part:

"I have come here to fulfill the pleasing and usual duties of my position on such an occasion by welcoming you to Boston. This city has been distinguished as a meeting-place for many organizations, partly because of its natural attractiveness, but more on account of its well known hospitality.

"The purposes of your organization are those that have the greatest interest for those interested in the technical development and financial progress of the country. It is not possible to find anywhere such another rapid and important development as that of the electric arts in the comparatively few years since the formation of your institute. That date—16 years ago—marked the ending of the experimental and tentative period and the beginning of assured practicality in electrical engineering; it

was the starting point of the period in which large investments of capital could be made in electrical systems and developments. The invention and perfection of the telephone, the electric light, the electric railway and the electrical transmission and distribution of power form a period of unprecedented development. The future will probably look back to the last 15 years as the most interesting period in the history of the development of electricity.

"It is probable that the discovery of means for generating electricity from mechanical power, and its transmission and subsequent utilization, ranks next to that of the availability of steam as a prime mover. The enormous effect of the telephone upon business and even in social relations, the great development of the electric light, the gigantic growth of the electric railway—all show that this new agency has wrought an industrial revolution.

"While it seems likely that the great, fundamental inventions and discoveries in the electrical field have been made, there is yet much room for investigation and study, for improvement and development, of the more scientific side of the subject. Great as the investment of money in electrical enterprises has been in the last 15 years, I believe the investment in the next 15 will be greater.

"It is most desirable that men engaged in the study of this subject should be gathered together in this way. Development along any line of industry is led by comparatively few —by those who study and think. Of all the manifestations of nature, electricity has been hardest to lay hold upon and most difficult to understand. The field is still big with promise and fruitful of results. There is very much yet left to do in it. I do not see how there could be a more interesting occasion than this gathering of the representative men of this important branch of engineering. Your mutual exchange of ideas can not fail to be of benefit, both to you and to others."

In thanking Mayor Quincy for his address, President Kennelly said: "I think the fact that His Honor is not a member of the Institute is merely a mistake. He has handled his subject in a way that shows his entire eligibility to be one of us."

Secretary R. W. Pope then read a number of invitations for the members present to visit points of interest, etc., among them letters from the president and regents of Harvard University, the New England Telephone and Telegraph Company, the Boston Electric Light Company, the American Telephone and Telegraph Company, the General Electric Company, the Boston Elevated Railway Company, the Mayor of Cambridge, Mass., the New England Gas and Coke Company, and from past-president Elihu Thomson, inviting the members to an informal reception at his residence in Swampscott, Mass.

The report of the Committee on Standardization was then presented and accepted. This committee was appointed two years ago and made a preliminary report at the Omaha meeting last year. This has been revised and amended, and in its present form represents no little labor and thought. The report will be published in full later.

Mr. C. P. Steinmetz then read his paper on the "Symbolic Representation of General Alternating Waves and of Double-Frequency Vector Products." This paper, whose length and mathematical character forbid its republication in full, or its abridgement, is one of the most important ever presented to the Institute. It is an extension of the author's application of the algebra of complex imaginary quantities to the consideration of power and torque. These, being represented by the product of two vector quantities, in the notation of the author's former analysis of alternating-current phenomena, contained always a somewhat unintelligible imaginary quantity. By introducing the conception of double-frequency — for the second degree quantities, such as power, contain a duplication of the frequency element —Mr. Steinmetz has succeeded in presenting an elegant and harmonious symbolism and a mathematical method for calculation and investigation of remarkable simplicity and flexibility. This work completes his classical labors upon the theory and analysis of the alternating current.

The difficulty of fitting the assumption of a sine-wave current to the observed facts in circuits where resonance effects come into play are practically solved by this new calculus. The second part of this remarkable paper gives applications of the new analysis to problems connected with induction motors worked in "concatenation" and to circuits containing capacity. Here the effect of harmonics was shown, certain phenomena of important, practical bearing, and hitherto beyond analysis, being explained.

The discussion which followed the reading of the paper was rather a tribute to the remarkable mathematical abilities of the author than an actual discussion. Dr. C. T. Hutchinson said that, while the paper could not be fully comprehended without detailed study, it was well worth that labor. Dr. Louis Bell spoke of the growing importance of a study of harmonics and their phenomena, and the utter impotence of sine-wave formulæ to deal with long-line questions. "This new analysis," he said "will help us to 'lick into shape' the practical consideration of phenomena of harmonic resonance."

Prof. Elihu Thomson said that the new work "gives us methods of understanding and predicting results where formerly we have had to blindly experiment." President Kennelly said: "The paper is a land-mark in methods of calculation, and promises to be most important in the future of the only analytical method competent to deal with alternating-current questions—the vector formula." He illustrated by means of diagrams upon the blackboard, the importance and significance of the new methods.

Prof. W. E. Goldsborough said that, from the standpoint of the universities, he wished to thank Mr. Steinmetz for a method which "shows the student how the use of complex quantities make complex problems simple." He said that he only expressed a gratitude which would be shared by all educators. Mr. C. A. Adams said that the whole significance of the subject of alternating currents was changed by the view given in Mr. Steinmetz's paper. The higher harmonics are of enormous importance in practical work, especially upon the vast networks of underground cables for alternating-current supply. Mr. T. J. Johnston called attention to a typographical error in the printed copy of the paper. The discussion continued for about an hour in this vein, Prof. H. J. Ryan, Professor Sheldon and others taking part.

The next paper was by Mr. P. R. Moses, entitled "The Cost of Electricity in Some Typical Buildings in New York City." It was a study of cost of current supply by isolated installation rather than from the central stations in various sizes and types of buildings, including hotels, office buildings, loft buildings, department stores and apartment houses. Mr. Moses leaned toward the side of the isolated plant somewhat, giving the cost of a kilowatt-hour, as generated by them, at from two to five cents, while he averaged the charges of the illuminating companies at 10.6 cents. He dwelt at length upon the advantages of accumulators in isolated plants, and upon the vital importance of the use of the exhaust steam for heating.

Mr. H. Ward Leonard, in opening the discussion, said that the isolated plant vs. the central station was an old subject. He told of data he had gathered 12 years ago which showed that then the cost of a kilowatt-hour averaged about 3.3 cents. It would be about three cents to-day, considering the same elements of cost in both cases. He believed that Mr. Moses's estimate of five per cent each for depreciation and interest was too low, and that the value of the space occupied by an isolated plant, not to speak of an accumulator, also, was of great importance in this connection. In a modern office building the space taken by the isolated plant is a continuous charge against it. But few isolated plants, said Mr. Leonard, can use accumulators on account of space, but in those that can, a charge should be made to cover the cost of the expert attention required to keep the battery in good order. The above question, he thought, is one of the value of exhaust steam. The elevator is an important and disturbing factor. Each case, he said, should be studied by itself, and the owner of a building would always do well to have the advice of a competent and unprejudiced engineer.

Mr. Arthur Williams, of the New York Edison Company, then began an elaborate refutation of Mr. Moses's arguments, quoting many figures from the records of his company. Mr. Williams spoke for about 40 minutes, and made out a strong case for the central station. His figures did not agree with those of Mr. Moses in most cases.

Mr. H. B. Coho said that, since both central station and isolated plant investments were growing, the question must have two sides. Mr. Steinmetz suggested the importance of improving the elevator motor by reducing its excessive starting current.

Mr. Moses, in reply, entered into a general explanation of his position and quoted many of the original figures he had used in the compilation of his paper.

Mr. A. D. Adams, whose paper was next upon the list, being absent, Prof. H. J. Ryan read his paper on "Poly-phase Electric Testing," which will be published in the next ELECTRICAL REVIEW. Mr. Steinmetz highly commended the paper, which he called "an elegant and even artistic solution of the problem." Professor Sheldon spoke of his experiments with the aluminum cell, saying that he had not found true polarization in it, but rather an electro-deposition of an aluminum salt and its re-solution in the electrolyte. In this view Mr. Steinmetz agreed, saying that the deposit is aluminum oxide and will not form in an electrolyte which will attack that substance. Professor Ryan said that the aluminum cell could be used with condensers to serve for the measurement of instantaneous maximum potentials. Prof. C. B. Mathews spoke of the recent work of Hotchkiss in perfecting the Blondel oscillograph (described at length in the ELECTRICAL REVIEW of May 24, 1899) and stated the results of its use in connection with the aluminum cell.

Prof. Frank A. Laws, whose paper was next on the programme, being absent, the meeting was adjourned, at 1.40 P. M., until the next day.

TUESDAY, JUNE 27.

The day's proceedings commenced promptly at 10 o'clock, with the reading of Dr. Allan V. Garratt's paper, entitled "Elements of Design Favorable to Speed Regulation in Plants Driven by Water-Power." The paper was not a discussion of water-wheel governors, but confined itself to those elements of the design of a water-power plant which favor accurate governing. The paper was long and interesting, bringing out fully the vital importance of the reduction of the mass of moving water by placing the wheel as nearly as possible directly under the upper level water—in other words, by making the descent of the water as nearly vertical as possible. The paper was illustrated by many lantern slides.

Mr. Hopewell opened the discussion by stating it was better to have the greatest possible head above the wheel, rather than to use long draft-tubes.

Prof. W. S. Aldrich asked about the effect of throttling the discharge, in the way practiced at Niagara. The relay type of governor, he said, seemed to be the one generally preferred, and gate regulation most usual because it is easiest to install. The trouble of "hunting" or over-regula-

tion is one difficult to overcome. Few of the wheel governors now on the market would fail to regulate for slow variations of the load, but it is equally true that few of them would respond to quickly varying demands. It seems almost impossible to meet the variations of a street-railway load with any kind of governor. Still, he thought, it was not essential that a governor should respond to minor variations of load. He asked if it was considered good practice to use conical ends on draft tubes.

Mr. C. W. Rice said that, in many plants, economy of water was a desideratum. He was more familiar with high-head work, such as is met in the western states, than with low or medium-head installations. In the latter, where stand-pipes near the turbine are used, he asked what was the practical limit of their height?

Dr. Garratt, replying, said that about 70 feet seems to be the practical limit for stand-pipes. As to throttling, it can not be worked at high heads on account of the inertia of the water. Relief valves are of little value in such cases. Draft tubes, with cone-shaped ends, are ideal in efficiency, but not always practically applicable where several tubes are installed close together. In this case the water must be given a chance to get away, and the tubes are generally directed so as to start the tail water away from the wheels.

Referring to quick-acting governors, he said that the quicker a governor started the better—provided it stopped in the right place. It is more important to *stop* the gate at the right place than to start it at the right time. A good governor, in his opinion, should move the gates from full open to shut in about two seconds. To illustrate how important to regulation was a nearly vertical movement of the inflowing water he cited cases of wheels working under 200 feet and five feet head, in both cases the regulation being good.

Mr. Steinmetz said that many engineers had learned to their sorrow that water-wheels can not be regulated because of the inertia of the moving column of water. Oscillations of speed, or hunting, were due to minor variations of load, the governor generally overshooting the mark and going too far. This rhythmic variation of speed is particularly serious when the circuit contains synchronous machinery, all of which varies in speed with the generator. What is needed, he thought, is a governor which starts quickly and then slows down, reaching the end of its motion very slowly.

Dr. Garratt said that his paper was not about wheel governors, but concerning plants.

Dr. Louis Bell said that this was a peculiarly vital subject in the present state of the art. "We've all sorrowed over these things—hunting and bad regulation"—he said. "If hydraulic conditions are good, it is possible to attain fairly good regulation. The governor must not hunt. Whether it be quick or slow, if it goes too far in its attempt to regulate, hunting will surely start, and sometimes go on with increasing amplitude. Checking the governor a little before the end of its stroke is a remedy that has been applied with success, but the governor itself should be absolutely dead-beat. If it is prone to hunt, too much swiftness of action is inadvisable.

"Even with high heads and impulse wheels using the deflected-stream method of governing, there is liability to this hunting action, because so small a deflection of the stream makes so large a difference in the speed of the wheel."

He was glad that the author had brought out the utter uselessness of most flywheels. "Much metal is cast into wheels, for which bearings have to be provided, just to allow the use of bad hydraulic design. The facts show that governing is closely related to hydraulic design. The flywheel is the hundred tons of cure where a proper appreciation of hydraulic design is the ounce of prevention." Dr. Bell paid his respects to bad wheel design, and inquired why practically no turbines of the impulse type are used in the United States. All now in operation here are of the pressure type, though many of the impulse variety are in successful operation abroad.

Prof. W. E. Goldsborough said that the element of skill in economically handling such plants was one of great importance. When unskilled men undertook to operate the Minneapolis plant he had heard that there had been trouble, fits of hunting and surging, etc. He thought brains were as important in the operation of a plant as in its design and construction. Professor Goldsborough gave an interesting account of three plants in Utah which, though 30 miles apart, are so well regulated that they are run in multiple. Mr. Rice gave some further data concerning these plants.

Mr. H. Ward Leonard related an experience he had had with a plant having auxiliary steam engines, in which he found that the high-speed engines acted well as governors, either aiding the wheels or acting as brakes upon them if they tended to overrun their speed. Mr. W. J. Hammer gave an interesting account of a plant erected in Florida 11 years ago, in which the turbine was mounted directly upon a spouting artesian well.

Dr. Cary T. Hutchinson then read his paper, entitled "The Protection of Secondary Circuits from Fire Risks." This paper was a plea for the abolition of the underwriters' rule requiring the insulation of all parts of a house wiring system from the ground. That this is a dangerous arrangement has been repeatedly shown, and that better protection, both from fire and fatal shock, may be had by grounding one side of a secondary system of distribution, is beginning to be understood. Dr. Hutchinson's paper contended for the grounding of secondary systems and the consumer's circuits, and closed with the following resolutions:

"*Resolved*, That this institute favors a rule permitting the grounding of one wire of every low-tension consumption circuit.

"*Resolved*, That the Committee of the American Institute of Electrical Engineers on the National Electrical Code, is hereby requested to confer with the Electrical Committee of the Underwriters' National Electric Association, in relation to recommending to the National Board of Fire Underwriters the passage of a rule permitting or requiring the permanent grounding of one wire of distributing systems under suitable restrictions.

"*Resolved*, That they also confer with the same committee in regard to recommending to the National Board of Fire Underwriters some modification of Rule 39 of the Code in relation to the installation of secondary wires when the primary wires carry a current of over 3,500 volts potential."

The long discussion that followed this paper was rather a commendation of it and the ideas contained in it than a discussion. It can be reported here only in a very brief manner.

Professor Thomson said that it was proper for him to open the discussion because he was the first to start the agitation of the question. In the early days of alternating lighting he had patented the grounded secondary, grounded shield, and film cutout. Indeed, he had had a feeling that no alternating system was fit to use without such protection.

Mr. C. M. Goddard, in formally seconding the resolution, said that he wished the institute to help the Board of Underwriters to a proper understanding of the questions involved. Mr. Goddard made some very interesting remarks from the standpoint of the underwriters, and spoke of the trouble of applying new rules to old installations. He told of the fear felt by firemen of high-tension overhead wires in city streets, and concluded by saying that the board was ready to meet the position of the institute.

Professor Goldsborough said he felt it was not always best to ground the secondary. Of all devices of that character, he thought it the best, but he believed it to be a step in the wrong direction. He said it would give the people who install wiring a chance to escape the consequences of bad work. He suggested overload and voltage tests of installations after they were completed.

Mr. Steinmetz said that an overload test meant nothing, because fuses take care of overload. To use wrong fuses is, in his opinion, criminal. He would like to see it not only permissible but obligatory to ground the middle point of secondary circuits. He indorsed Dr. Hutchinson's resolutions, but would like to see them made stronger. An absolute and permanent ground is the only safeguard against fire-risk. In an underground system it is the surest protection against electrolysis.

Dr. Bell said that initial conditions mean nothing. In the present state of the rubber market, when we get corn oil and linseed oil residues for pure Para rubber, what we need is assurance against danger when the plant gets old. Test the installation by all means, if that is desirable, but be sure to ground it, too, so that it will remain safe.

The circuit of maximum danger is the series arc circuit. There are more accidents from these than from any other. Why, then, should the underwriters make stringent rules against the secondaries of 3,500-volt circuits when they admit arc circuits on poles running up to 7,000 volts? These arc wires are a menace to all others. Dr. Bell spoke also of high-tension three-phase transmission lines, where the neutral points should be grounded. "The application of one-half the present underwriters rules with rigidity," he said, "would be better than the publication of an octavo volume of new ones."

Mr. Ayer spoke of his experience 10 years ago with a grounding and circuit-breaking device to diminish the danger from a short-circuited transformer.

Capt. William Brophy spoke at length of the conditions 15 years ago and of his gradual change of conviction that had led him to believe in grounded secondaries. "Much of the blame for trouble," said he, "lies with the peculiar creature called contractor. Some are conscientious and honest, others should be in jail." Captain Brophy thought that the burden of supervising installations should lie upon central stations and municipal inspectors, not upon the underwriters. Grounding the neutral of the three-wire system in Boston had produced no evil results.

Prof. W. L. Puffer spoke of the position of the insurance companies, and related the history of their efforts to obtain better conditions.

The discussion continued in the same vein for some time, Messrs. Steinmetz, Thomson, Goldsborough, Goddard, Rice and Hammer taking part. President Kennelly summed up the situation in a few convincing remarks, and Mr. S. D. Greene spoke in favor of a definite expression of opinion by the institute upon this important matter. The resolutions were then unanimously adopted.

The hour being late, an adjournment was taken, a group of members remaining a few minutes to be photographed by Dr. A. V. Garratt who, on behalf of the entertainment committee, undertook to furnish each member with a print.

In the afternoon the ladies of the party were taken to Harvard University, several carriages and seven electromobiles being used.

WEDNESDAY, JUNE 28.

The morning session began with the reading of Mr. S. Everett Doane's paper, entitled "Plea for a Working Standard of Light," which was discussed at some length by Messrs. Steinmetz, Matthews, Kennelly, Goldsborough, Blood, Clough and Puffer. Professor Goldsborough moved that a committee be appointed to further the formation of a national testing laboratory. The delegates moved to authorize the council of the institute to proceed in the matter.

Mr. Alton D. Adams read an address, entitled "Motor Speed Regulation," which was discussed by Mr. Blood and the author. Prof. J. P. Jackson's address on "Electricity in Mining" was read by Prof. Dugald C. Jackson, and was discussed by Messrs. Perry, Aldrich, Adams and Stine. Following this came Professor Goldsborough's address on "Air Gap

(Concluded on page 407.)

SCIENCE BREVITIES.

Purification of Oils by Ozone—Ozone has been applied for some time, says *L'Industrie Electro-Chimique*, for the purification of linseed, cottonseed, palm and colza oils. The process of purification of linseed oil consists in bubbling ozonized air through it while the oil is kept at an elevated temperature in a steam-jacketed kettle. In this way the oil is freed of the water and impurities it contains. It seems to preserve all its qualities and to be only a little thickened after treatment. The ozonized air is first pumped through a drying chamber, having shelves on its walls packed with quick-lime, and is stored in steel tanks under pressure. For purifying a ton of oil about 350 cubic yards of ozonized air are required. According to Dr. Lewkowitsch this quantity can be produced with Yarnold ozonizers at a cost of about 40 cents. In works handling five tons of oil per day the cost of the treatment will not be more than $1.80 per ton, this comprising the interest, depreciation, etc. Palm, cottonseed and colza oils are purified in almost exactly the same way.

Reversed Interrupter—Fizeau and Foucault's luminous electrolyte, which has just been utilized with such striking results by Wehnelt, was studied as long ago as 1891 by E. Lagrange, who described the periodic interruptions of the continuous current traversing the cell in either direction. After the publication of Wehnelt's contrivance, the same author set himself to produce the "unstable" phase at the cathode instead of the platinum anode, says the *Electrician*. The interest attached to this attempt lies in the fact that at the anode only a noble metal can be used, in consequence of the evolution of nascent oxygen, whereas the hydrogen developed at the cathode would not even perceptibly attack iron. The main difficulty lies in the rapid rise of temperature of the liquid, which soon brings about the stable condition with continuous current. The author, therefore, constructs the cathode of small bars of copper attached to a large sheet of the same metal outside the liquid. The sheet presents a large cooling surface, which keeps down the temperature. The sheet may also be replaced by a copper vessel containing cold water constantly renewed. The author has thus succeeded in interrupting currents of 40 to 100 amperes, with or without inductance in the circuit, and in imitating Wehnelt's induction-coil phenomena.

A Magnetic Decoherer—T. Tommasina, working with coherers made of magnetic metals, says the *Electrician*, has made the important discovery that the presence of a magnet immediately destroys the conductivity of the coherer created by the impact of the electro-magnetic wave. He has applied this discovery to wireless telegraphy by substituting an electro-magnet for the tapping device used by Marconi. The electro-magnet is fixed a few millimetres above the tube containing the filings, which is kept in a horizontal position. The circuit is formed by an accumulator, a resistance and a relay for opening and closing the circuit of the electro-magnet, with two accumulators and a telephone receiver in a suitably-shunted branch circuit. The adjustments once being made, the messages work perfectly with tubes containing steel, iron, cobalt, or nickel filings. The movement of the filings is clearly visible with the naked eye, and resembles a pulsation of striking regularity. The instrument is not put out of order by the shaking of the floor nor by knocks given to the coherer. As in other cases where electric or magnetic processes are substituted for mechanical effects, much is gained in the way of precise control of the action in question. Branly himself recently pointed out the very variable effects of mechanical shock, and mentioned the desirability of a remedy.

A Thermo-Electric Standard Electro-Motive Force—It has long been desirable, says *L'Industrie Electrique*, to have a standard of electro-motive force giving exactly one volt or one-half or other aliquot part of a volt. This seems to have been realized in new thermo-electric combination due to Prof. W. F. Barrett, of Dublin. He writes as follows to the *Engineer*:

"In your admirable report of the Royal Society soirée of May 3, you refer to a new thermo-electric combination which I exhibited, consisting of a nickel manganese iron alloy, coupled with nearly pure iron as the second metal. This combination, as you correctly state, I found to give a nearly constant electro-motive force (4,000 micro-volts) from 300 degrees C. to 1,000 degrees C.; that is to say, the thermo-electric current is practically independent of temperature through the enormous range of 700 degrees C. It is this fact, which is, I believe, unique in thermo-electricity, that renders the combination so interesting from a theoretical point of view. Probably it may also be valuable practically, not, of course, as a pyrometer, but for attaining a constant electro-motive force; 250 of such couples—the cool junctions being kept at 0 degree C.—will give just one volt in any common gas flame." The alloy used was made by the Hadfield Steel Foundry Company, of Sheffield.

In addition to the convenience of this standard, due to its voltage being one volt direct, the thermo-couple is so mechanically strong and simple that such standards might easily be made in portable form.

Ether Wave Warning Signals—In a letter to *Engineering* Mr. J. T. Bucknill makes some sensible suggestions concerning the use of Marconi signals for warning ships away from dangerous neighborhoods. Speaking of the loss of the ship "Stella" on the Casquet rocks, he says: "By using verticals at the Casquets of varying heights, and by sending warning signals from each in turn, a vessel suitably fitted on approaching the rocks would receive these signals differently at different times according to the distances from the Casquets. For such a purpose the largest vertical need only to be sufficient for a range of, say, 10 miles, and two others might be used, say, with ranges of six miles and three miles, respectively.

"Assume that the signal 'CAS' is sent from each vertical consecutively in a group signal at intervals of, say, two minutes' lapse. The specially-fitted vessel on entering the 10-mile circle would receive the signal 'CAS' every two minutes; after crossing the 6 to 10-mile annulus, and on entering the six mile circle, her receiver would record the signal 'CAS, CAS' every two minutes; after crossing the inner annulus, and on entering the danger area of three miles' radius from the Casquets, she would receive the signal 'CAS, CAS, CAS' every two minutes, and her commander would know that he was within three miles of the Casquets, and would take action accordingly.

"The signals and the variation of the electrical attachments to the verticals at the Casquets would, of course, be done automatically; as, for instance, by a revolving drum (like that of a barrel organ) wound up against a spring or a weight, and arranged to be stopped or started at will. The signals could thus be started at once by day should the weather become foggy."

Electrolytic Decomposition—An interesting paper on this subject by E. Bose occurs in the *Zeitschrift für Elektro-chemie*, and is abstracted by the London *Electrical Review*. The author states that he has repeated and confirmed the observations of Glaser on the electro-motive force necessary for the decomposition of water, and then extended his experiments in order to determine the points at which decomposition begins in different solutions. The general conclusions arrived at are as follows: The determination of the point of decomposition is preferably made with the help of a continuously increasing voltage and not by a step-up arrangement. This is accomplished by winding the resistance spirally on an insulating drum which is driven at a suitable rate by a motor. The rate can also be varied by a system of change wheels, whilst the resistance itself is continuously tapped all along its length by a small loose pulley bearing on the wire and running on a shaft parallel with the axis of the drum. Deviations of the curves from the theoretical form, especially with very dilute solutions, are due to differences in the concentration of the electrolyte round the electrodes, and hence the most accurate results are obtained by using the smallest possible currents. Extremely well marked points of decomposition are obtained on the deposition of solid substances, whilst if soluble substances, and especially if gases are liberated at the electrodes, the curves show a gradual rounding off near the point of decomposition instead of an abrupt change of curvature. The influence of temperature and concentration on the electro-motive force required for the decomposition of silver nitrate solutions was also carefully investigated, and the results are given in tabular form. Solutions of copper salts show two characteristic cathodic points of decomposition, the lower one of which is probably due to the presence of $\overset{+}{Cu}$—$\overset{+}{Cu}$—ions. An oxygen electrode is strongly depolarized in solutions of mercurous salts. Silver is deposited from nitric acid solution as a singly charged ion, $\overset{+}{Ag}$. In general, acids show just as many points of decomposition as there are ions split off on progressive dissociation. Both acids and alkalis show the anodic point of decomposition, observed by Glaser, at 1.08 volt due to the presence of $\overset{-}{O}$ ions, and corresponding to the point of reversal of the gas battery.

Electric, Steam or Gas Power?

To the Editor of Electrical Review:

We read with considerable interest the article on "Gas Engines," wherein you state a 650-horse-power engine has been giving such good results, and would be glad to hear your opinion as to the following:

We contemplate introducing power in a new warehouse which we are about to occupy (for the manufacture of paints and colors), and the very serious problem confronts us which power to use; viz., steam, gas or electric.

Our requisites for manufacturing will be for about 40 to 50 horse-power. Can you advise us which method is the best for us to use to get maximum results and minimum cost, and at the same time be the most economical for us as an investment?

When we talk to gas-engine concerns, we are readily convinced that their power is the best. The same is the case when we consult electric-motor people, and when we speak to steam concerns we are told that neither gas nor electricity can compare with their steam engines.

It is our wish to get an opinion from a concern like yourselves, who have no axes to grind and unhesitatingly tell facts.

We lean favorably toward steam, because with one engine and boiler we could heat the building (five floors 30 by 175 feet and cellar), and also run an elevator and outside cellar lift with this same power (now run by hydraulic); and we could also produce our electric lights. The only fault is that steam power would heat the first floor considerably, would it not? An early reply with full information will oblige.

Yours very truly,
Hirshberg, Hollander & Co.,
28 West Lexington street,
Baltimore, Md., June 9.

[This is a case requiring the services of an engineer. The best advice the Electrical Review can give its correspondent is to go to a competent engineer and pay him a small fee to inspect their premises, look into all the conditions bearing upon the subject, and advise them. There are many engineers competent for this work in Baltimore.—Eds.]

The Massachusetts Institute of Technology receives, under the will of the late R. C. Billings, of Boston, a bequest of $100,000, and an additional $50,000 to establish a fund to assist students who do not use liquor or tobacco.

An Electric Coffee Roaster.

In roasting coffee the temperature must be under perfect control and the turning motion of the roaster steady and continuous. The illustration herewith, taken from our English contemporary *Lightning*, shows an electrically driven and heated machine made by a British concern. The large globe

An Electric Coffee Roaster.

contains the berries which are to be operated on, and heat is conveyed to them by means of a resistance network placed between the inner and outer skins of the receptacle. The plug and cord on the left show the method of making connection with the mains. The little motor on the right looks after the oscillation and revolution of the globe, so as to give each berry its due share of that heat which dries the juices, liberates the invigorating aroma, and renders soluble in boiling water the stimulant alkaloid that is the "soul" of coffee. The reducing gear on the right of the machine gives a maximum of 40 revolutions per minute to the globe, but by the use of the reducing switch the speed can be regulated for any smaller number. The capacity of the machine at one "charge" is 11 pounds, and as each filling only takes some five minutes to roast, over a hundredweight of coffee can be turned out in an hour. This is a standard trade size, but probably smaller machines for domestic use will follow if the invention achieves its deserved success. Hitherto gas has held the field for trade purposes, but its fumes and general inconvenience will have sealed its death warrant the moment that the advantages of the new arrival shall have secured the appreciation of the public.

The National Export Exposition.

On September 14 there will be opened, in Philadelphia, an exposition of American manufactures and products suitable for export.

Ample appropriations by the Congress of the United States, the state of Pennsylvania and the city of Philadelphia, supplemented by the generous contributions of the citizens of Philadelphia, provide money sufficient to carry out the plans of its projectors on a liberal scale. The exposition is held under the authority of Congress, and is endorsed by the principal Chambers of Commerce, Boards of Trade and other commercial organizations, representing every state in the Union, which are giving active support and encouragement to the enterprise.

Alongside the American goods will be shown specimens of the competing European goods which are now sold in the future American export market. The government has appropriated $50,000 for the purchase of these samples.

Methods of packing and labeling, to conform to transportation and other exigencies, customs rules, etc., will be shown. The illustration herewith shows the main building, which has been erected in a convenient and accessible situation. Inquiries should be addressed to Mr. H. P. Denton, Chief of the Department of Publicity and Promotion, Philadelphia.

Main Building, National Export Exposition, Philadelphia.

Automobiles to Remove Ashes.

It is reported that the Boston City Council has entered into a contract for the removal of the city garbage and ashes by automobiles.

The Electromobile and the Chicago Parks.

To the Editor of Electrical Review:

The South Park Commissioners of our city recently undertook hostile legislation of barring automobiles off the parks and boulevards of the South side of our city. They put the order into active operation on Monday, June 19, and we immediately took steps to test the legality of the act. We now have the matter pending in court, and expect a speedy decision in our favor.

It is pleasing to note that the public in general, particularly the majority of prominent citizens and business men, are emphatically in favor of the encouragement of the general adoption and operation of electric vehicles, anywhere and everywhere throughout the city.

We feel that this action, instigated by two or three members of the South Park Board, will result advantageously to the industry, and eventually cause legislation under which horses will be charged a license to travel upon the parks and boulevards, inasmuch as they are a source of considerable expense to the public in wearing out the surface of the streets, and causing a considerable additional expense in maintaining forces of men to keep the roadways clean over which they pass.

We feel that in fighting this case, and procuring an early decision, that it will establish a precedent to be followed by all other large cities throughout the United States.

Yours very truly,
American Electric Vehicle Company.
C. E. Corrigan,
General Manager.
Chicago, June 21.

Military Wireless Telegraphy.

Experiments are now being carried on under the supervision of the officers of the French Army with a view of determining the value of the aerial telegraph for military service. Communication has been established between the Bureau Central des Telegraph, in the center of Paris, and the Fort of Mont Valerien, in the suburbs. The apparatus at the city end has been installed on the tower formerly used for the ancient system of semaphore signals. The officers of the telegraph corps of the army have the direct supervision of these experiments, and favorable results have been obtained. In a short time the system is to be established between the forts in the neighborhood of the city, after which a still further extension is expected.

Electrical Review

OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.

TIMES BUILDING, 41 PARK ROW,

P. O. BOX 2330. NEW YORK.

NEW YORK, JUNE 28, 1899.

CHARLES W. PRICE, - - - - - - - EDITOR.
STEPHEN L. COLES, - - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - NEW YORK.

TELEPHONE CALL, 1548 "CORTLANDT."

NEW YORK OFFICE:
RUSSELL HOWLAND, GENERAL REPRESENTATIVE,
Times Building, 41 Park Row.

WESTERN OFFICE:
FRANK E. COLBERT, REPRESENTATIVE,
960-965 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - REPRESENTATIVE,
800 H Street, N. W., WASHINGTON, D. C.

LONDON OFFICE:
HENRY W. HALL, - - REPRESENTATIVE,
42 Old Broad Street, LONDON, E. C.

News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week, although it is occasionally possible to get in matter received on Monday.

Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - 5.00
Single Copies, - - - - - - - - - - .10
Copies can be supplied for only one year back, at 25 cents each.

CONTENTS.

The Institute Meeting 401
Dr. Arthur Edwin Kennelly 401
Telephone Convention in Chicago 401
Science Brevities 404
Electric, Steam or Gas Power? 405
An Electric Coffee Roaster 405
The National Export Exposition 405
Automobiles to Remove Ashes 405
The Electromobile and the Chicago Parks 405
Military Wireless Telegraphy 405
Electric Traction in New York City 406
Electromobiles and the Ideal City 406
Progress of the Electromobile 406
Personal 407
Canadian Electrical Association 407
International Congress of the Paris Exposition of 1900 407
Information Wanted About a Resistance Material 407
Electric Storage Battery Company's New Officers 407
A Power-House Site for the New York Elevated Railway 407
Radiant Electric Forces 408
The Bullock Electric Manufacturing Company's New Plant 408
Convention Incidents 411
"Electromobile" Letters 411
Something New for Independent Telephone Companies 411
Automobile, Ala. 411
Notes on Underground Distribution of Two-Phase Current in New York City 412
Plea for a Working Standard of Light 414
Late News 414
Electricity in Southern Hotels 414
Air as a Motive Power 414
A Reminder of Independence Day 4 4
Motor Speed Regulation 415
A New Electrical Supply House in New York City 415
Wall Street and the Electrical Stock Market 415
Storage Battery Injunctions 415
Advance Information 416
Chicago Trade Notes 416
Book Reviews 416
Kindred Interests xix
Electrical Patents xx

Advertisers' Alphabetical and Classified Index on page xvi.

ELECTRIC TRACTION IN NEW YORK CITY.

The almost complete replacement of all other traction systems in New York city by the underground conductor electric railway has been one of the most notable features of recent electrical advance. While much has been done, there still remains much more to do, and so long as the Manhattan Elevated Railway shall remain as it is—a crude and unsightly makeshift, tolerated only because of the absolute necessity of some kind of transit facilities—there will always be an opportunity of the first class for electric traction.

So much has been said and written about the advisability of an electrical equipment for this railway that it is hardly necessary to enter here into the reasons for it. It would be more interesting to know the reasons that have led the proprietors of this system, owning a franchise as valuable as that of any public corporation whatever, to let the railway fall behind the march of progress and become decadent, as it is already. The surface lines, with their rapid and attractive cars, have taken away a large part of the business of the elevated railway system.

The elevated railway is in a peculiar situation. Either it must adopt electricity or else continue to lose patronage as at present. It is doubtful whether an underground railway system can be constructed and operated at a profit, even with the vast travel that such a line would accommodate, for the reason that New York city is underlaid with stone of peculiar hardness and difficult of working; and this, instead of being continuous, is seamed with fissures containing quicksand and sea-water. The expense of constructing a tunnel road in streets already filled with water, gas and other pipes, conduits, etc., and where the abutting property is of almost fabulous value, would probably be too great to encourage its undertaking.

It has not yet been proposed to construct what might be called an underground railway on the surface, and yet this could be done and would offer a less costly solution to the difficult problem of rapid transit in New York. If a street running north and south could be condemned to the use of the railway and roofed over at the level of the second stories of the buildings—the intersecting streets being carried over by easy grades—the effect would be practically the same as if a tunnel had been constructed. Through this street-level subway high-speed expresses at short intervals could be operated, and transfers given to surface cars running on the upper deck. The first floors of abutting buildings would be then cellars, while what are now the second floors would become the first or street level floors. The elevated street would still be useful for haulage, etc., and the right of way of the railroad beneath it would be entirely private and unobstructed. In such of the intersecting streets as are carried over there would be, of course, a closing of the ground-floor levels of some buildings, resulting in a damage to their rental values, but there would be a corresponding enhancement of rental values of their second floors. The sidewalks could be laid on a level with these second floors, with stairways at convenient intervals. While such a structure would probably require the purchase of all the property fronting upon it, and much of that on the side streets, it seems reasonable to think that this would be a paying investment. With a system of this kind, reserving the upper level for surface-car lines, pedestrians, bicycles and lighter forms of carriages, a service far better than that of the elevated railways could be given, and the undertaking could, in all probability, be made to pay a large dividend to its promoters.

ELECTROMOBILES AND THE IDEAL CITY.

The esteemed Baltimore *Sun*, commenting upon an utterance in these columns some weeks ago, when it was contended that horses were responsible for most of the noise and dirt in our cities, harks back to the good old days when street cars were dragged along by two bony equines with jingle-bells on their collars. It says: "The roar of the electric car in the silent watches of the night is terrible—a nuisance, in fact. . . . The noise of the wheels on the tracks, the squeaking of the trucks, and the clouds of dust raised as the electric car comes thundering by, detract materially from the value of rapid transit." What a street car system they must have in Baltimore! It was not contended in the original article on this subject that horse drawn vehicles should be replaced by steel-truck, motor driven carriages running on rails, but by electromobiles having rubber tires and running on asphalt. It must be a curiously attuned ear that does not prefer the somewhat musical roar of well meshed gearing to the "clap-clap" of horses' hoofs and the rattle of steel tires over a cobblestone pavement. Looking forward into the happy future when this state of things will obtain, there is but one serious drawback that seems to attend the universal adoption of electromobiles. It is that pedestrians will have to use their eyes rather than their ears in avoiding such vehicles at crossings.

PROGRESS OF THE ELECTROMOBILE.

The electromobile is humming along the path of progress at a great rate with all the accompaniments and interesting side effects incident to the development of a new invention. One got itself arrested the other day for going too fast, and another, in making a short turn, hit the curbstone and collapsed upon and within itself. Now the electromobiles have got the horse cab drivers down on them. The Liberty Dawn Association of Livery Coach Drivers and the Rising Sun Association of Livery Stablemen, of New York city, will fight the bill providing that none but competent electricians can have charge of electromobiles when that bill is introduced in the legislature next session. They say that the electromobiles will drive hundreds of horse cabs and carriages off the streets and that it is unfair to deprive their drivers of a chance of taking charge of the electromobiles.

THE INSTITUTE MEETING.

(Concluded from page 403.)

and Core Distribution; the Magnetic Flux and Its Effect upon Regulation and the Efficiency of Dynamo Electric Machinery," which was discussed at some length by Messrs. Steinmetz, Blood and others. An address, entitled "Operating Costs of Horses and Electric Delivery Wagons in New York City," by George F. Sever and Robert A. Fliess, was read by Mr. Sever. Mr. E. A. Sperry then delivered an address, illustrated by the stereopticon, entitled "Electric Automobiles." A short discussion followed.

A committee, of which Mr. W. J. Hammer was chairman, offered a vote of thanks to the city of Boston, the Massachusetts Institute of Technology, Harvard University, the New England Telegraph and Telephone Company, the American Telegraph and Telephone Company, the West End Street Railway Company, and others, for their courtesies to the visiting members. President Kennelly made a brief and appropriate address and the meeting adjourned.

The Boston local committee arranged an interesting series of excursions for the visiting members. On Monday special cars conveyed a large party to the Boston Terminal Station, whose many engineering features were inspected. Special cars then proceeded to the Boston Electric Light Company's station, and returned to Copley square. On Tuesday a visit to Harvard University and the Lawrence Scientific School was provided. The physical and engineering laboratories and Prof. John T. Trowbridge's 20,000-volt battery plant were inspected. The Harvard power station of the Boston Elevated Railroad Company was also inspected, as well as the plant of the New England Gas and Coke Company. On Tuesday evening a trolley ride to the Norumbega Recreation Park was enjoyed. On Wednesday, special trolley cars conveyed the members to a steamboat, provided by the city of Boston, which sailed for Pemberton, where connection was made with the cars on the Nantasket branch of the New York, New Haven & Hartford Railroad. The over-head trolley and third rail systems and the power-house were inspected.

Through the courtesy of the New England Telephone and Telegraph Company, Mr. J. N. Keller, general manager, a telephone desk set was placed in the secretary's office for the use of members in communicating through the Boston and suburban exchanges. The American Telegraph and Telephone Company also extended the courtesy of the use of its lines to members for long-distance service between the hours of 6 P. M. and midnight, from the pay station at the Hotel Brunswick.

A newspaper cablegram from Berlin declares that the officials of the German Foreign Office are negotiating with British firms for the laying of the German-American cable.

PERSONAL.

Carl A. Bessey, A. B., and B. Sc. in electrical engineering of the University of Nebraska, has been appointed assistant professor in the department of mechanic arts in the Agricultural and Mechanical College, Stillwater, Okla.

The Fort Wayne Electric Works, of Fort Wayne, Ind., have placed Mr. G. A. Wilbur in charge of their Philadelphia office, 101 The Bourse. Mr. Wilbur is ably assisted by Mr. A. H. Jones and Mr. E. H. Porter. The territory covered by this office will be the same as heretofore.

Mr. J. J. Nate, general manager of the Standard Telephone and Electric Company, of Madison, Wis., renewed a number of old-time friendships in New York city this week. Mr. Nate represents one of the strong independent companies manufacturing high-grade telephone apparatus, and is quite properly very enthusiastic over the great promise in this branch of the electrical industry.

Mr. L. G. Martin, of Bermuda, was a visitor in New York last week, en route from Jamaica to his home. Mr. Martin is an experienced cable operator and manager, and was in charge of the office at Jamaica during the Spanish-American war, handling the work during this difficult period with rare tact and ability. The newspaper correspondents of New York well remember Mr. Martin and his efforts to treat them all fairly. He returned to Bermuda on Saturday's steamer.

Canadian Electrical Association.

As already announced in the ELECTRICAL REVIEW the annual convention of the Canadian Electrical Association is being held this week at the New Royal Hotel, Hamilton, Ont. The convention dates are June 28, 29 and 30. A report of the proceedings will appear in the next issue of the ELECTRICAL REVIEW. Among the papers to be read are the following:

"Meters," A. A. Dion, Ottawa; "Cost of Power," C. B. Hunt, London; "Inspection," W. J. Plewes, Montreal; "The Enclosed Arc Lamp and Its Use," W. A. Turbayne, Hamilton; "The Incandescent Lamp for Central Stations," E E. Cary, St. Catharines; "Central Station Accounting from a Business Point of View," P. H. Hart, Montreal; "Transformer Economy," F. E. Leonard, Jr., Montreal. In addition, there will be a "question box," and Mr. H. R. Leyden will lead a discussion on high-tension power distribution.

INTERNATIONAL CONGRESS OF THE PARIS EXPOSITION OF 1900.

BY FRANCIS E. DRAKE, DIRECTOR OF MACHINERY AND ELECTRICITY FOR THE COMMISSIONER-GENERAL OF THE UNITED STATES.

The Universal Exposition of 1900 is certain to prove a Mecca to a great number of scientific men and engineers. This gathering together of technical men from all parts of the world justifies the French electricians in their efforts to organize an International Electrical Congress, which has already received the official patronage of the French government. In previous conferences questions of units and nomenclature have been settled by international agreement, to the great advantage of all concerned. Since the International Electrical Congress at Chicago, in 1893, there have been unexpected discoveries in the application of what seemed once to belong to pure science and an extraordinary expansion of the various electrical industries. Engineering practice has thus awakened an interest in a great number of problems, on which it will be interesting and profitable to have the views of technical authorities. The discussion of the proposed congress will, therefore, have a character at once both industrial and economic. The work before the proposed congress is provisionally divided as follows:

1. Scientific methods and instruments of measurement.
2. Production of electrical energy, transformers, distribution, electric lighting, traction.
3. Electro-chemistry, electro-metallurgy, accumulators, electric furnaces.
4. Telegraphy, telephones and various applications.
5. Electro-physiology.

The congress will last one week, beginning Friday, August 18, 1900.

The administration of the exposition has arranged with the Commissioner-General for the United States for the appointment, under him, of an official delegate, with headquarters in Paris, and through him all correspondence and plans of the organization may be transmitted. The Commissioner-General has wisely named as his official delegate, under this agreement, the Assistant Commissioner-General, who is in constant touch with the authorities and abundantly able to conduct any conferences which may be required prior to the opening of the congress.

The method of choosing delegates will be proposed by the authorities at a later date, and a subscription for membership has been placed at 20 francs, merely a nominal fee to apply toward the current expenses of the reporting staff, etc.

Any communications which may be directed to the Commissioner-General, at either New York or Chicago, will receive prompt consideration. It is to be hoped that an early conference may be held with the American Institute of Electrical Engineers, and other scientific bodies interested in this work, so that proper representation from the United States may be assured.

Information Wanted About a Resistance Material.

An English correspondent asks the ELECTRICAL REVIEW for the name and address of the manufacturer of a special resistance material, known in England as "Eureka." The ELECTRICAL REVIEW will thank any of its readers for the information requested above.

Electric Storage Battery Company's New Officers.

The board of directors of the Electric Storage Battery Company has organized by the election of Isaac L. Rice, president; George H. Day, first vice-president, and Herbert Lloyd, second vice-president and general manager. Mr. Day is president of the Columbia and Electric Vehicle Company and vice-president of the Pope Manufacturing Company, of Hartford, Ct.

A Power-House Site for the New York Elevated Railway.

President George Gould, of the Manhattan Railway Company, of New York city, issued this statement on June 27:

The Manhattan Railway Company has secured a location for its power-house at Seventy-fourth and Seventy-fifth streets and the East River. The plot has a frontage of 204 feet on the river by 570 feet on the side streets, enough space to install the power for the elevated system and allow for an increase in growth of 50 per cent. The contract for 9,000 tons of third rail, weighing 100 pounds per yard, has been given to the Lackawanna Steel Company, the delivery and installation of which will commence in September. During the past week competitive bids have been received from the largest engine builders and boiler factories in the country, which are now being tabulated and compared for the action of President Gould and the executive committee.

We have received from Mr. William J. Hammer a chart, lithographed in colors, showing graphically his experiments in phonographic and telephonic transmission of sound between New York and Philadelphia in 1889.

RADIANT ELECTRIC FORCES.

BY ALFRED G. DELL.

In the following article I propose to deal in a brief manner with some of the forces radiated throughout space from induction coils, and their discharges in vacuum tubes.

We find in electric waves two forces, one propagated perpendicularly to the other; they having at the same point, one a node, and the other a loop, or one an antinode as respects the other, both being reflected by metallic sheets, one showing the greatest energy in a detecting circle, held properly to detect the force under examination, and the other the least at the same point. Both forces are propagated to great distances from the source of the waves. Both forces act in a similar manner, except that one is always the reverse of the other at the same point. Both forces affect a circle having open only a spark-gap, or a circle in two equal parts when properly held, but the circle in two parts is not so sensitive. Both forces produce interference, etc.

When a sheet of metal is connected to one end, the positive end preferred, of the secondary of an induction coil, a small coil preferred, and the other end of the secondary is earthed, the sheet becomes heavily charged with every break of the primary of the coil, and the energy is as rapidly radiated into space. The effects of the discharge are seen in the lighting up of Geissler tubes and the sparking of a circle of wire with a spark-gap having the wire broken opposite the spark-gap, making the circle in two parts. This sparks more brightly if there is greater capacity in one side than the other, and sparks in almost any position in which it can be held, but not at anything like the distance from the sheet, at which sparks appear when the electro-static discharge is produced by a spark from the secondary of the coil. Here is one circle, closed excepting the spark-gap, sparking at great distances from the source, and with a restriction in the positions of the circle, while the other circle, that has to be in two parts and has scarcely any restrictions of positions, sparks only at short distances.

I detected no segments in wires when this electro-static discharge was used, whereas, with both the electro-magnetic and electro-static discharges from a Hertz arrangement, when working properly, the segments are always produced, one always in the reverse order as regards the other. I found no such phenomenon as reflection with this electro-static force.

The interference phenomenon is present in another form, operated in an entirely different manner.

I obtained no effect on a coherer from the radiation of this electro-static force, but the smallest possible spark to earth would cause a violent throw of a galvanometer needle used in connection with the coherer to detect the radiation.

In the equation, using the x direction, $u = \frac{df}{dt} + p$; where the resistance is infinity $p = o$; where u represents the true current and $\frac{df}{dt}$ the time variation of the electric displacement, and p the conduction current, $\frac{df}{dt}$ (as the equation stands) would represent the last electro static force, there being no spark in the secondary of the coil; but by substituting the values of the magnetic induction for u, we have an entire change in the equations, and now there are two forces propagated throughout space perpendicular to each other and their direction, which we find is correct from experiment, when there is a spark in the secondary of the coil.

A. B. Basset, in his treatise on physical optics, to make the direction of the disturbance which constitutes light perpendicular to the plane of polarization, supposes that the disturbance is represented by the electric displacement. Now I find by experiment, although the electric displacement (electro-static force) appears to be nearly, if not always, present with the magnetic displacement (electro-magnetic force), it seems to be somewhat the weaker force of the two. Hertz failed to detect this force at as great a distance as he did the electro-magnetic. The body of the person examining this force has an enfeebling effect on it as regards the detecting circle. One force is shown to be perpendicular to the direction and the other parallel to the direction of the wires in the wave producer.

The former would vary inversely as the distance and the strength of the latter inversely as the third power of the distance from the source of the waves. Either the above is false or my coils falsify, as I have traced the presence of the electro-static force nearly as far as the electro-magnetic. The difference in the intensities given above is too great.

In wireless telegraphy, if the two upright wires have capacities in sight of each other, the electro-static force will act along with the electro-magnetic.

Light can be polarized by various means, one of which is a block of Iceland spar; in electric waves we have, as a counterpart to the above, a plane of close parallel wires cutting off the radiation in one position and allowing it to pass in another position of the wire grating. To my mind this is very much in favor of the belief that the waves are transverse, certainly not longitudinal, vibrations.

Some seem to think that if the sender and receiver in wireless telegraphy could be brought to resonance, secrecy would be accomplished. While I failed to find anything like resonance in my experiments, the only thing that I found was that, if the capacity near the spark-gap of the circle used was too great, it would not spark at as great a distance from the producer, which was, on account of the capacity, causing too great a radiation, the energy preferring to radiate rather than to cross the spark-gap. There would be no reason why another receiver, not in resonance, a little nearer the sender, should not pick up the radiation if there was such a thing as resonance produced in wireless telegraphy. As for the use of parabolic reflectors, I imagine it would be a difficult job to arrange a pair at the distance of miles apart so that the sender would place the waves directly into the receiver. Besides, I think the waves would be found to spread out considerably more than anticipated. I think it is pretty certain that the radiation from the sender has a wide spectrum of wave lengths.

When a zinc sheet is used as a reflector, we find a detecting circle, independent of its size, always indicates a node for the electric and a loop or antinode for the magnetic waves directly at its surface. Any circles used as detectors indicated the wave lengths to be always about eight times the diameter of the circles instead of twice their circumference, the same results as obtained by Sarasin's and De la Rivés's experiments as given in J. J. Thomson's Electricity and Magnetism.

Space seems to be a conductor for radiation, its conductivity increasing with the increase of the electro-motive force and rarefaction of the air to a certain extent, while when the vacuum is raised to a certain further extent the phenomena of the discharge change. Any one experimenting with an induction coil knows that when its secondary is opened there is a series of noisy sparks, but when the opening is slightly beyond what is called its sparking distance there is still a shower of fine sparks, generally colored, between the points; but when a vacuum tube is inserted in the secondary of the coil, the light obtained branches out, generally filling the whole tube, the noise of the spark having ceased. As the vacuum of the tube is raised the cathode discharge appears to predominate, whereas, with the spark in air, the cathode side appears to be far the weaker discharge. I have found in experimenting with a quite small Crookes tube, which I had raised to such a vacuum that a small spark produced but feeble X-rays, that it become nearly inactive for the small spark, but active for a larger spark. I examined carefully the cause of its inaction with the small discharge, and found there were cathode discharges entering the tube, they appearing white on the glass walls of the tube; but the anode discharges did not enter the tube at all, but discharged on the outside of the tube near the entrance. I tried to force the discharges to enter the tube by placing wax on the leading-in wire of the anode, but failed, as the discharges followed the wax back. It may be that the resistance of a vacuum has more effect on the anode discharge than the cathode, which is certainly indicated by the above described experiment.

The Bullock Electric Manufacturing Company's New Plant.

As an example of the advance which is being made in the large manufacturing establishments of today, attention is called to the new manufacturing plant of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. There is no better example of a complete and modern plant in this country.

The plant embodies the latest and best ideas as to economy of production, and every facility for producing electrical machinery of the highest order. But in securing the most economical features for the actual production of the goods, the welfare of the artisan has also been fully considered, both as to health, comfort and pleasure.

This model plant was completed last Summer, and the Bullock Electric Manufacturing Company moved in the first of the present year. The buildings are located at East Norwood, Ohio, one of the suburbs of Cincinnati, which is less than five miles from the heart of the city. The Baltimore & Ohio Southwestern Railroad crosses the Pennsylvania lines at this point, and both roads have tracks entering the works, giving the Bullock company excellent shipping facilities.

Perhaps the first impression received by the visitor to the works is the simple yet beautiful architecture of the several buildings; second, the great amount of light and general cleanliness within. The buildings are constructed of light buff pressed brick with appropriate trimmings of stone, and separated from each other by grass plots, flowers and shrubs.

One can not think of anything which would facilitate and render more comfortable the pursuit of duty by officer, clerk or workman in the new plant than these light, airy and pleasant surroundings; and a vast amount of thought and care, not to mention expense, has been necessary in securing these results.

The plant comprises the administration building, machine shops, foundry and power-house. In the first mentioned are the general offices, drafting and pattern rooms, lunch room for officers and heads of departments, with a completely equipped kitchen and pantry, general lavatory and locker rooms for workmen.

In the main hall of the administration building is an office of the Postal Telegraph company and a telephone exchange, with lines extending to the various departments of the works.

The offices are provided with all modern conveniences, and finished in quartered oak with partitions, doors and windows of stained and plate glass. The dressing-room section set apart for mechanics and shop employés is not only provided with the usual toilet arrangements for the men, which, by the way, are thoroughly modern in every detail, but there is also a complete system of

lockers and baths. Each man has a locker under key placed at his disposal, and in the lavatory are set bowl, shower and needle baths. Great credit is due the Bullock company for their thoughtful regard of the comfort and welfare of their employés.

The drafting and pattern rooms are on the second floor of the administration building, and are very light and commodious. The kitchen and lunch room, also on this floor, are homelike in equipment and decoration.

mosphere and absence of the noise due to constantly running belts and shafts. The application of independent electric motors for power purposes is here shown to be the ideal method.

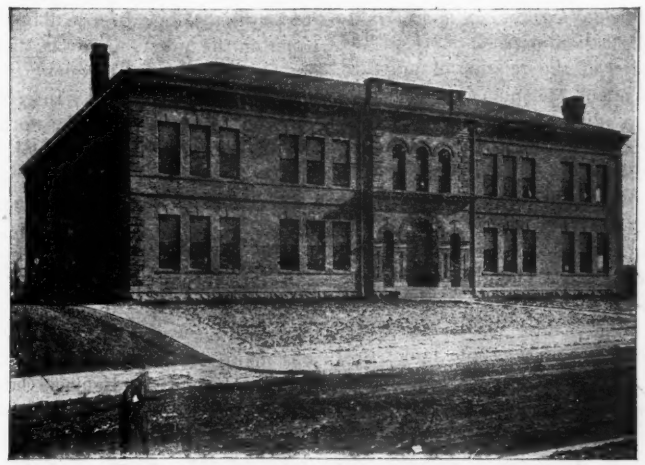
Among the machines equipped may be mentioned cranes, power presses, lathes, planers, drills, milling machines, profilers, emery grinders, hydraulic presses, boring mills, etc. The motors used for driving these various tools are designed and adapted for the tools mentioned, and are built into the headstocks of lathes, while in

fies the additional expenditure. The output of the tool is largely increased on account of the multiplicity of speed obtainable, and the facilities for changing these speeds while the tool is in operation. Space is economized, as the tool may be located without reference to line shafting.

The power-house is provided with vertical water tube boilers, equipped with automatic stokers. A cross-compound engine, direct connected to two of the Bullock Electric Manufacturing Company's engine type generators, supply current not only for the light-

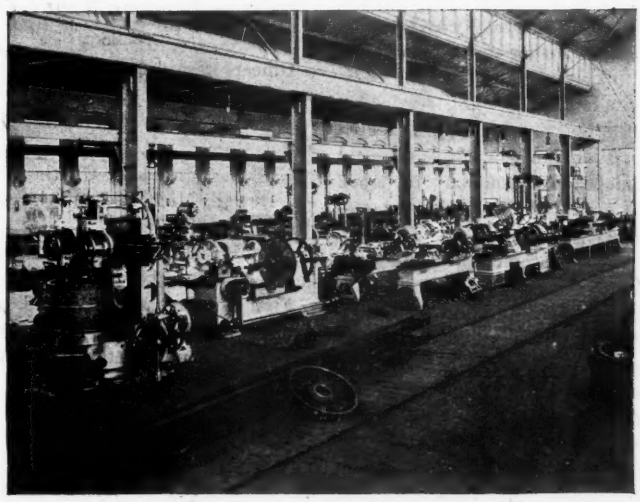
and hot air is conveyed hence underground to its destination.

Altogether the plant is a notable one, and one which is worthy of a visit from any manufacturer contemplating a change of power or material reconstruction of shops of any kind. There are many large plants in the country, but the Bullock company may safely assert that there are none more nearly up-to-date in equipment, from a manufacturer's point of view, or more thoroughly designed to make business life a pleasure for every one.



ADMINISTRATION BUILDING.

MACHINE SHOP.



MACHINE DEPARTMENT.

TESTING DEPARTMENT.

SOME FEATURES OF THE BULLOCK ELECTRIC MANUFACTURING COMPANY'S NEW PLANT AT EAST NORWOOD, OHIO.

The machine shops of the Bullock works are models, and illustrate the great economic progress made in manufacturing methods. A better illustration of modern machine shop methods could hardly be found. There are no long lines of shafting and counter-shafting; no unsightly and light-forbidding belts; each machine in the Bullock works is driven by an independent Bullock electric motor, which absorbs power from the transmission lines only when it is required, and, by reason of all this, one is deeply impressed with the improved at-

other tools they take the place of the driving pulley and require no more room. The motors are of the Bullock slow-speed type, with the variable speed control governed by the Bullock multiple voltage system. The tools may be operated in six varying speeds in either direction, without the use of back gearing or any resistance whatsoever in the electrical circuits. The economies effected by application of motors to machine tools, although in first cost slightly more expensive than the use of line shafts, belting and counter shafts, soon justi-

ing system, but for the Bullock multiple voltage power transmission system used throughout the entire plant. An elaborate switchboard has been erected with the necessary electrical instruments and switches, including recording wattmeters registering the amount of power being used on the various circuits. A section of this building, occupying the whole southerly end, is set apart and fitted out for the employés' lunch room. Apparatus for heating the general machine shops is located in the basement of the power-house,

Every machine employed is modern; every labor-saving and labor-facilitating device which could be profitably employed is there; every economic problem has been carefully worked out, and the logical result is a plant which is modern in every particular, creditable alike to its originators and to the city which has been favored with its location.

The officers of the Bullock Electric Manufacturing Company are: George Bullock, president and treasurer; J. S. Neave, vice-president, and James Wilson Bullock, secretary.

TELEPHONE CONVENTION IN CHICAGO.

(*Concluded from page 401.*)

body of men were present. A number of ladies also had accompanied the delegates, and gave color and grace to the scene.

The officers and members of the executive committee, whose names were published in the ELECTRICAL REVIEW alone of all the electrical journals last week, were present with scarcely an exception, and it was the comment of all that a great impetus would be given to the telephone industry by the developments of this convention. The papers gave evidence of much thought and care in preparation, and the discussion was at times animated and always enthusiastic.

President J. M. Thomas's annual address was as follows:

At this the third annual meeting of the Independent Telephone Association, indications are not only very encouraging but fraught with bright promise for great future success. This large meeting indicates more than this. It shows conclusively that the work accomplished in the last two years is appreciated.

We have further evidence of this approval in the large number of letters from those who can not be with us, tendering their good-will, and expressing a desire that the organization go on to the accomplishment of greater things. I know of no clearer or more expressive language than that found in the Constitution, in Article XI, as follows:

The object of this association shall be:

SECTION 1. The protection of all independent telephone interest of common concern to the members of the association.

SEC. 2. The protection of subscribers to telephones and apparatus operated by members of this association.

SEC. 3. The bringing about of a reasonable charge for tolls and the rental of telephones, so that the telephone may be within the reach of the masses of the people.

SEC. 4. The bringing about of a complete system of inter-municipal communication and long-distance trunk lines.

We have accomplished to a remarkable degree all the objects set forth, but have now reached a condition where there is greater demand than heretofore for a close organization, which has at its command all the facilities and men necessary to meet the attacks of our opponents in their fight for existence in certain territory of the United States.

We now need in each state an organization similar to the new State Company of Michigan, the new Long Distance Telephone Company of Indiana, The United States Telephone Company of Ohio, and other state companies, to connect up by first-class copper metallic circuits the local exchanges of the different states, upon an equitable basis. Their organization should be encouraged by the local companies and by the state association, and should have the assistance and support of this general organization. Then the state companies should join their wires, giving to us a complete long-distance system, so that words of good cheer can pass throughout the land from the strong to the weak.

We hail with delight the advent of better apparatus; and a trip through the factories, stores and exhibits to-morrow morning will convince you that long strides toward perfection have been made by the manufacturers since our meeting one year ago.

Without very much organized effort through the attention of individuals large capital has become interested, and the year just closing finds the independent telephone interests with sufficient capital at its command to carry on the work, by the purchase of labor and material faster than they can be supplied. The factories, without exception, have increased their capacity and new ones have started during the past year.

In certain parts of the United States the rural districts are already well developed, and the work is going on throughout the entire country in the smaller towns and cities.

We had at the time of our last meeting, according to our statistics, about 1,100 independent telephone exchanges in operation in the United States. The year just closing, has started into operation more than 1,200 in addition thereto, making a total of more than 2,300 telephone companies under the independent system now in operation.

There are several hundred more in process of construction, and a great number of companies which have franchises or are seeking franchises which have not yet begun to build.

While the number of telephone exchanges more than doubled the past year, the investment more than quadrupled on account of the fact that larger exchanges with more expensive equipment were among the number of increase. We have now in operation many thousand miles of toll lines. The various independent companies are operating more than 575,000 telephones, not including those operated outside of public exchanges and toll-line companies. There is to-day already invested in independent telephone exchanges and toll lines more than $55,000,000, while many millions of capital are engaged in manufacturing and furnishing supplies to the operators.

Much surprise is expressed throughout the country at the great success of the independent companies. Our neighbors thought we would certainly be swallowed up by the great monopoly, as it was called. But we have not been, but still live and flourish, and our number is being multiplied.

After the expiration of the basic patents and its monopoly of 17 years, which our government seeks to give to the inventor (who rarely gains the object intended by our government), the people demanded cheaper telephone service, which was refused by the Bell company. Cheaper telephones were not only refused, but the same arbitrary rules were enforced against the people. The people grew tired and commenced to build and patronize independent telephone exchanges, and are going to continue so to do until they possess the telephone field.

But, it is asked, why did not the Bell company reduce prices? They did not because they could not. They could not because the parent Bell had tied the hands of the lessee companies so that they were to have paid more royalty per year upon each instrument than the instrument would sell for in the market.

I know of some farmers who built their own telephone lines nearly 20 years ago, who paid to the Central Union Telephone Company $10 per month for each instrument they used for the first two years, and, after a long struggle, succeeded in reducing the amount.

At the same time they were selling to a company of the farmer's neighbors, for use in South America, similar instruments for $10 each.

The wonder then is not that the independents succeed, but that any fail. None ever fail except those built with wind and watered stock. Place money, energy and honesty behind your proposition and the people will do the rest.

But these are not all their troubles.

Some of the sub-Bell companies have already laid down their burdens which have been assumed by others within the past year. We are told that one of the large sub-companies refuses longer to pay royalties, because of the expiration of the basic patents.

The Western Union Telegraph Company, with several other plaintiff companies, have brought suit against the American Bell Telephone Company under the Western Union-Bell contract, in which they seek an accounting in stocks and dividends amounting in the aggregate to about $10,000,000.

The coming year no doubt will be one of interest and importance to both sides. We should be always ready and on the alert. Station your men in proper position. See that they are well equipped, and have your gunners stand close by your guns.

Mr. S. P. Sheerin then read a paper, entitled "Value of Long-Distance Toll Lines," which was discussed at considerable length by Messrs. DeLand, Harvey, Reutinger, Hill, Fair, Critchfield, Cockrell and Fricker. The discussion partook more of the character of the relation of practical independent telephone experiences than a direct discussion of Mr. Sheerin's address.

Mr. Fred DeLand suggested that the independent telephone people would make a good point by taking up the toll-line question on the Sabin system. Mr. Sabin, he stated, had made a signal success by cutting up the minute into halves and three-fourths; very few people understood that they could talk 70 words in 30 seconds. Sabin gave a rate of 10 cents where the three-minute rate would be 30 or 35 cents. "A man," Mr. DeLand continued, "often closes a deal in 20 or 30 words." He favored building lines as strongly as possible.

Mr. E. B. Fisher stated that he did not think it necessary for the independents to give free toll service because the Bell people did. He stated that in Michigan a fair price was paid the independent company for good service, even if the Bell company gave free service; all that was necessary was to let the people know the point at issue.

Concerning the question of division of tolls over several connecting companies, there was quite a division of opinion. Mr. Critchfield's suggestion that the originating company should take 25 per cent, and then divide the other 75 per cent equally, was met with applause. Mr. Cockrell stated that he had been very successful in handling the toll business by having each company take what it collected, and had found it very satisfactory. He thought that the building of trunk lines by long-distance companies was necessary, so that the toll business could be turned over to them.

Mr. E. B. Fisher followed with a paper, entitled "Operation and Maintenance." The discussion was begun by Mr. Fair, who desired the president to call upon some one who had had experience to inform the meeting of the proper size of plant to be run at the minimum of expense. Mr. DeLand followed and suggested that it would be a good idea to have a committee prepare what might be called "Specifications for Franchises," to be used by the association. Mr. Critchfield and Mr. Hogue also took part in the discussion. Mr. Fisher, the author of the paper, replied to the discussion briefly.

The next paper read was that on "Essentials of Telephone Construction," by Mr. Maxime Reber, of Cleveland, Ohio. Mr. Reber's paper was read by Mr. G. W. Beers. The next paper on the programme was that by Mr. Critchfield on "Development of Independent Telephone Interests," which gave a review of the work accomplished. There were many bright prospects for the future in this remarkable development, the speaker stated.

The discussions and papers, which will appear more fully in the next issue of the ELECTRICAL REVIEW, were well received and much interest was manifested.

The convention adjourned late in the afternoon leaving the election of officers for the ensuing year until the following day.

OFFICERS ELECTED WEDNESDAY, JUNE 28.

Officers were elected as follows after some general discussion:

President, James M. Thomas, Chillicothe, Ohio.

First vice-president, Charles Flowers, Detroit, Mich.; second vice-president, I. A. Lumpkin.

Secretary and treasurer, S. P. Sheerin, Indianapolis, Ind.

First assistant secretary and treasurer, G. W. Beers, Fort Wayne, Ind.; second assistant secretary, S. E. Wayland.

Executive committee: J. S. McConnell, G. W. Beers, E. L. Barber, J. B. Ware, William Miller, George M. Bandy, Samuel E. Wayland, E. K. Cole, W. A. Hewitt, S. A. Sapp.

Advisory board: J. M. Thomas, S. P. Sheerin, H. T. Critchfield, Hugh Doherty, E. B. Fisher, Thomas W. Sennott, W. H. Durin and W. B. Seaton.

On Wednesday afternoon a tally-ho ride was taken through the boulevards to Jackson Park. This was enjoyed by about 250 of the delegates. A banquet was given at the Auditorium Hotel in the evening, which was attended by about the same number. A number of interesting toasts were responded to and the occasion was a pleasant winding up of a very successful meeting.

S. H. G.

CONVENTION INCIDENTS.

Mr. Wm. T. Blaine, of the Victor Telephone Manufacturing Company, of Chicago, was indefatigable in making arrangements for the welcome of the telephone guests. Mr. Blaine's efforts in behalf of the furtherance of the telephone industry made him a prominent figure at the meetings.

The interests of the Sterling Electric Company were well cared for by Messrs. Doolittle, Cook and a corps of able lieutenants. The uniformed messengers who did service for the Sterling Company were a unique feature of the gathering. The company had a complimentary carriage service between the Auditorium and the factory, and a great many exchange visitors took the opportunity to see the new 500-drop switchboard for the exchange at Mattoon, Ill.

The exhibit of the Eureka Electric Company, Room 636, Auditorium, was looked after by I. J. Kusel, Arthur Stein and M. McNeil. Their apparatus consisting of the various makes of telephones, generators and the Eureka switchboard was displayed attractively. Numerous patrons and friends called upon them at their headquarters and also at their factory.

The American Electric Telephone Company showed their telephone apparatus and switchboards at their factory on Canal street. Mr. P. C. Burns spent a great deal of his time at headquarters at the Auditorium. The American Electric Company distributed a neat souvenir. They had several electromobiles standing at the door of the Auditorium for the convenience of visitors.

The Western Telephone Construction Company were well represented by Messrs. Keelyn, Dodge, Nolan and Bisland. The company had a very elaborate line of apparatus open for inspection at their salesrooms, and visitors were welcomed at the factory. Mr. Keelyn, president of the company, who himself is one of the earliest pioneers, was welcomed by many of the old-timers.

The Stromberg-Carlson Telephone Manufacturing Company were able to take visitors to a number of their installations, which were in practical operation in the city of Chicago. Among them the Board of Trade Building, equipped with the new central energy system; Masonic Temple, with the S.-C. inter-communicating system; the Stewart Building, having a 150-line switchboard and central energy system; Peoples' Gas, Light and Coke Company Building and the American Trust and Savings Bank. Messrs. Stromberg, Schaefer, Bowman and others were present for the company.

Messrs. Jas. A. Williams and Burt Hubbell of the Williams' Electric Company, of Cleveland, were both in attendance. The company had shipped several of their most recent instruments for exhibition, and the splendid mechanical and electrical construction of this apparatus was a matter for general interest among the visiting exchange men. Mr. Burt Hubbell, who by the way, has been identified with the growth of the independent telephone interests since the inception, has been suffering from an abcess and spent the last two days in Chicago against the advice of his physician.

Mr. F. H. Murray represented the National Carbon Company, of Cleveland, and had an attractively arranged display of carbon telephone specialties and telephone batteries.

The Electric Appliance Company, of Chicago, had B. B. Downs, W. J. Upton, A. L. Millard, S. A. Dinsmore at the convention to welcome their friends and customers. Their new building was inspected by visitors and the company were the recipients of may congratulatory remarks by the delegates.

The National Automatic Telephone Company, of Chicago, in connection with the working apparatus at their factory, had an exhibit in Parlor 14, Great Northern Hotel, where they received a number of visitors interested in their automatic telephone and switchboard system. Mr. F. A. Lundquist looked after the interests of this company during the meeting.

The Central Telephone and Electric Company, of 909 Market street, St. Louis, were among the out-of-town exhibitors, and Mr. J. S. Cummings, president and general manager, was on hand to show to visitors the telephone apparatus manufactured by his company. This company is one of the most progressive and active of the manufacturers west of Chicago.

The Holtzer-Cabot Electric Company, of Boston, was well represented by Newman H. Holland. The company had a number of its Standard generators on view and a line of telephones and specialties.

The American Electrical Works, of Providence, were represented by E. H. Hammond.

The Chicago Telephone Supply Company were represented by G. A. Briggs.

The Central Electric Company, of Chicago, were represented by Chas. E. Brown, F. M. Pearce and S. A. Cobb, and their offices and factory were open to visitors during all the days of the convention, where an agreeable welcome was extended the telephone visitors.

Mr. J. I. Wiley, of the Standard Underground Cable Company, was registered at the Auditorium.

The Ericsson Telephone Company, of New York, importers and manufacturers of the well known Ericsson transmitter, telephones and switchboards, was represented by Messrs. D. G. Smith and J. E. Miller, with headquarters in the Auditorium.

Mr. E. L. Brown, eastern manager for the American Electric Telephone Company, with offices at Pittsburgh, was present.

Mr. A. L. Daniels, representing the H. B. Camp Company, manufacturers of Camp's underground conduit, was registered at the Auditorium.

The Sterling Electric Company entertained the delegates and their friends on Tuesday evening. A special train carried them out to the new Sans Souci Park, which was recently opened by the Chicago City Railway Company. The park is one of the beauty spots of Chicago, and the trip was heartily enjoyed. A vote of thanks was extended to the Sterling Electric Company for their generous entertainment.

Mr. James Wolf, representing the New York Insulated Wire Company, was a visitor at the Auditorium.

Mr. L. Sands, of the Williams-Abbott Electric Company, Cleveland, was among the prominent telephone manufacturers present.

"ELECTROMOBILE" LETTERS.

"ELECTROMOBILE" IS THE LOGICAL SELECTION.

To the Editor of Electrical Review:

I beg to thank you very much for the issue of the REVIEW containing the findings of the committee for the selection of a "baptismal" name for an electrically propelled vehicle.

"Electromobile" is certainly a very good name for scientific purposes, and, I think, the only logical selection, but the public at large may find it a trifle long.

Very truly yours,
Electric Vehicle Company.
FRED. VIEWEG,
General Manager.

New York, June 20.

MR. WOODS'S OPINION.

To the Editor of Electrical Review:

Replying to your letter of recent date regarding name for self-propelled vehicles, while I consider "Electromobile" a good name for electric vehicles, I do not think it is broad enough gauge to apply to self-propelled vehicles in general. I would suggest "Autobain" as having a wider significance, being more easily spoken, and it has this additional feature. The driver of such a vehicle, whether lady or gentleman, can be designated by calling one an "Autobaineer" and the other an "Autobaineeress." I would consider this quite an essential feature from many points of view, as it is not pleasant to call them drivers or anything of that kind. This name also applies to any form of self-propelled vehicle and is very general in its application.

Very respectfully yours,
Fischer Equipment Company.
C. E. WOODS,
Managing Director.

Chicago, June 20.

MESSRS. MORRIS & SALOM EXPRESS THEIR OPINION.

To the Editor of Electrical Review:

Your favor of the 9th, in relation to the determination of an appropriate name for electrically propelled vehicles, duly received and noted.

While we have no desire to criticise the work of the committee, we do not believe that the word they have selected, "Electromobile," will obtain, as while it is more specific than "Automobile," the latter has attained such a vogue already as to make it difficult to displace. Moreover, "Electromobile" is a mongrel, half Latin and half Greek.

When the necessity arose for giving a specific name to electrically propelled vehicles, after considerable thought and discussion, we adopted the name "Electrobat," and while it is perhaps not so euphonious as "Electromobile," it is etymologically more correct. The suggestion is due to Mr. Edmund Clarence Stedman, the poet-banker, who some years ago wrote a charming article on "Aerial Navigation," which appeared in *Scribner's Monthly*, and in which he suggested the necessity of a new name for a vessel which went through the air, and in contradistinction to a baloon, more properly designated as an "Aerostat," he coined the word "Aerobat," the latter half of the word being derived from the Greek verb "banein," "to go," and when we were in search of a name, the word "Electrobat" naturally suggested itself. From the number of inquiries that we have had from all parts of the world, we are convinced that the word "Electrobat" has a large number of friends.

Yours very truly,
MORRIS & SALOM.

Philadelphia, June 14.

Something New for Independent Telephone Companies.

The Sterling Electric Company, 71-73 West Adams street, Chicago, announce a new departure that will be of interest to the independent telephone companies of the country. This improvement is known as the non-interfering party-line telephone system, and particulars will be given to those who write to the headquarters of the company in Chicago.

The Sterling Electric Company, as is well known, is one of the foremost manufacturers of complete exchange equipments and telephone switchboards, and its announcement of this recent development will undoubtedly attract the attention of telephone interests quite generally.

Automobile, Ala.

[*From the Louisville Evening Post.*]

If the march of improvement keeps up its lick they'll soon be changing the name of a sister Southern city to Auto-Mobile, Ala.

NOTES ON UNDERGROUND DISTRIBUTION OF TWO-PHASE CURRENT IN NEW YORK CITY.*

BY E. A. LESLIE.

The purpose of this paper is to comment briefly upon certain features of two-phase distribution in New York city.

The company with which I have the honor to be connected decided about two years ago to substitute two-phase for single-phase distribution, but one of the very first difficulties encountered was the subway situation, which, as you are all aware, is unusual and, perhaps, peculiar to New York alone. In the early days the high-tension companies operating in this city apparently imagined that they could go on lumbering up the streets with dangerous and unsightly poles and wires to an indefinite extent and for an indefinite period; and, relying upon the theory of vested rights, refused in the most peremptory fashion to devise and lay down their own underground systems. The result was special legislative enactment; the contracting by the state with a private concern for the furnishing of underground facilities and one general subway system of the simplest design for Manhattan Island, which all high-tension companies were obliged to use in common. Every engineer present will appreciate the difficulty of laying out an ideal underground system, even for one occupant, in a crowded and busy city like New York; yet to do so for one-half dozen actively competing concerns, with almost as many different systems, would be little short of a physical impossibility. The trouble is that with so many occupants it is not practicable to provide room under ground for junction boxes, large transformers and other apparatus necessary for a reliable system of meshed conductors, without which no company can, in my opinion, hope to compete to advantage with direct-current distribution.

Without junction boxes we were afraid to mesh our conductors, and for this reason and the possibility of patent complications we adopted the four-wire method, consisting of two circuits, the currents thereon differing 90 degrees in phase. These circuits are operated practically the same as single-phase circuits, except that their distributing mains necessarily parallel each other, and, therefore, while with single-phase distribution we formerly employed but one distributing main in any given section, we now employ two. This is, of course, necessary to enable us to supply current for power purposes in units of five horse-power or over; but it also has this decided advantage, that it enables us to provide, at slight expense, a second source of supply for lighting and single-phase motors, in large and important installations, where an interruption of considerable duration might result in serious consequences. For this purpose a special non-arcing switch is provided, making it perfectly safe for any one to throw over from one circuit to the other the heaviest loads our largest customers are ever likely to use. These loads sometimes reach as much as 100 kilowatts, but as our generators, ranging in capacity from 300 to 450 kilowatts each, all run in parallel, and the circuits consequently are all fed from common bus-bars, the unbalancing effect of such switching over is rarely felt to an annoying degree. Of course, it is always desirable to preserve a fairly good balance, and these switches are frequently employed for this very purpose.

Another advantage over the three-wire, two-phase system is the comparative ease with which trouble may be located and removed, a "short," for instance, on one phase not necessarily affecting the other; whereas, with a three-wire underground cable, the insulation of all the wires is likely to be destroyed in case of trouble, and both phases consequently interrupted until repairs can be effected.

We also continued the house-to-house transformer method except in blocks where one installation could be made to serve a number of customers; first, because to distribute from substations would involve large sums for rental or compel their being shifted about from time to time at the caprice of the property owner; second, the operation of such substations would involve more or less labor; third, the secondary wires would require large investment for copper, and, fourth, because the subway rental for the secondary wires would constitute a very heavy additional charge. We concluded, therefore, that the house-to-house method, under the conditions existing here, would be the more economical and in the end afford more satisfactory returns. This, however, would not be the case with exclusive and what might be termed "extraordinary" subway facilities of our own providing.

The most serious difficulty encountered was the switchboard and regulating apparatus. Formerly our generators were small, not exceeding 60 kilowatts each, and as they were run independently, the number of lamps connected on each circuit was necessarily governed by the capacity of the machine, and the regulation of the pressure was usually effected on the machine itself. The loads rarely exceeded 25 primary amperes, and could be switched from one generator to another without serious danger of arcing or practical interruption to the circuit. With the adoption of the two-phase system, however, generators of from 300 to 450 kilowatts were substituted and run in parallel; the number of circuits was largely reduced, and the loads on those remaining were increased to 100 amperes. We quickly found that we could not throw loads of 100 amperes at a pressure of 2,500 volts on the ordinary switchboard without dangerous arcing and annoying interruptions to lights and motors. Neither could we satisfactorily regulate our pressure. In order, therefore, to secure safety and convenience, and at the same time control the pressure of each circuit independently of the others, it became necessary to adopt a special form of switchboard and regulating apparatus, which was devised by Mr. W. F. Wells, the assistant general manager of the Manhattan Electric Light Company of this city, and a brief description of which may be of interest.

Our circuit records for the past 10 years made it plain that, with a constant pressure maintained at the different centers of distribution, the difference of potential required at the generating ends of the various circuits at any one time would not be more than 10 per cent of the total. We therefore brought out a third lead from the stator armatures of our generators so as to give us 10 per cent of the total voltage; that is, with the machine generating 2,500 volts on each phase, we should have between leads Nos. 1 and 2, 250 volts; between Nos. 2 and 3, 2,250 volts, and between Nos. 1 and 3, 2,500 volts. The six leads from each machine (three on each phase) are carried through a three-pole, double throw switch in the switchboard to the bus-bars, of which there are two sets of six each, as shown. Ordinarily, but one set of bus-bars is used, as the generators are run in parallel, the other set being held for testing or the operation of a circuit singly if desired. The circuits are connected to these bus-bars by similar switches. Lead No. 3 from the switch, after passing through an ampere-meter, goes direct to the circuit. Leads Nos. 1 and 2 are connected to the terminals of a single-wound transformer, sometimes called an "autotransformer" or "economy coil." This coil has 11 leads brought out, dividing the coil into 10 equal parts, each part representing one per cent of the total primary voltage. These 11 leads are carried to an 11-point switch of the regulator-head type, so that any potential between 90 per cent and full voltage of the machine (in one per cent steps) may be run on the circuit. We are, therefore, able to keep the station end of the circuit correct within one-half of one per cent.

Owing to the cost of subway rentals, and other reasons, we have been deterred up to the present time from using pressure wires from the centers of distribution. In order, therefore, to ascertain at least approximately what pressure is required at the generating station by each circuit at the various loads, we have taken a number of voltmeter readings at representative points on the distributing mains of each circuit and simultaneous readings at the switchboard, and from these have prepared schedules showing the voltage required for each five amperes of load. In some cases we have placed on the ampere-meter scale, directly underneath the ampere figures, the voltage required for any given load. These schedules require frequent checking and alteration whenever changes are made in the cables, or in case the centers of distribution vary with the season, the connection and disconnection of customers, or the inductive characteristics of the load.

Plug and cable connections were also added to the board in case greater subdivisions of circuits were needed than could be obtained on the two sets of bus-bars. The synchronizing devices and pilot lamps of the machines are connected across the 10 per cent coils, and, therefore, switchboard transformers are not required for these purposes.

Notwithstanding the greatest care in the selection of insulation and the most rigid specifications for the guidance of manufacturers, faults will occasionally develop in our cables. In such cases the necessary interruption to the circuit for purposes of repair is an exceedingly important matter. Therefore, to facilitate the removal of the fault as much as possible, it was formerly our practice, whenever one of our alternating circuits became earthed, to isolate it from the other circuits by throwing it on the "test" bus in connection with a spare generator and use a device for locating the trouble, which was designed by Superintendent Sparrow, of the Manhattan company.

A single-pole, double-throw switch is attached to the test bus, and from the center of this switch a lead is carried, through the primary of a transformer which has a red lamp connected across its secondary; then through the ampere-meter to the diagonally opposite outside poles of a double-throw, double-pole switch, from the other outside poles a wire is carried to ground. Current is supplied to the center connections of this switch by a small direct-current, shunt-wound generator having a capacity of about 10 amperes at 250 volts, and by means of this reversing switch the current can be sent through the circuit in either direction. In locating trouble the direct-current generator, which is belted to a five-horse-power motor, is started and the single-throw switch thrown on either side of the bus. If

*Abstract of a paper read before the National Electric Light Association, May 24, 1899.

the red lamp lights up, it indicates that the ground is on the other leg, and the switch is thrown over. The direct current is then brought up to about seven amperes and the reversing switch is thrown about every 15 seconds, which reverses the direction of the direct current flowing through the cable to the ground. The subway workmen then start out with a compass and go to a manhole through which the circuit in question passes. If, on laying the compass on the cable, the needle reverses every 15 seconds, they know the ground is farther from the station; if, however, the needle is affected every 15 seconds, it indicates that the trouble is between the manhole opened and the station, and they then open another manhole nearer the station. In this way they are able, without cutting the cables, to locate the trouble in a section between two manholes or handholes, or possibly in a manhole. Prior to the use of this device we were frequently obliged to cut in 15 or 20 places before locating the fault. In some cases, if the trouble is slight, we are able to repair it without shutting down the circuit, as the men are provided with rubber boots, and rubber gloves drawn on over buckskin gloves and an insulated box to stand upon, and can safely and quickly make a temporary joint that will answer every purpose until such time, say, early the next morning, as the circuit can be shut down without detriment to the customers. If, however, the trouble is extensive, the circuit is shut down at once and the repair made as promptly as circumstances permit. Trouble on series arc circuits is also located in this way, except that not more than about four amperes of current is used, because otherwise the cut out magnets tend to act and throw the regular lamp magnets in circuit, the resistance of which practically stops the flow of the current.

It often happens in running a large number of circuits from a common bus, that phenomena will arise that have a suspicious look and make it desirable to find out which particular circuit or circuits has caused the disturbance. It would have been disastrous to the money-making end of the business if every time something unusual manifested itself, we had made a practice of pulling circuit after circuit until the delinquent had been detected, and it therefore became desirable to be able to make reliable insulation tests while the circuits were in actual operation. In order to accomplish this, an arrangement of apparatus was devised, which is described as follows:

A spare generator is started and connected through its switches to the test bus. From this bus a line is carried through a high-tension switch and then through the primary coils of four transformers in series, the secondaries being left open. This line is then carried through the galvanometer, which is provided with the usual short-circuiting key and shunt; thence it goes to a battery of 100 chloride cells equipped with reversing key, and from thence to earth. The transformers used are of the ordinary 2,000 volt type (which is the pressure used on the system), and are of about two-kilowatt capacity each, which we have found by experience to be about the right size. The coils being in series, they offer very high inductive resistance to the passage of alternating current, but their resistance is practically nothing when measuring megohms with direct current.

In making the test we first ascertain the insulation resistance of the generator, test bus, leads, etc. The circuit is then thrown on the test bus and tested in the same manner as if it were not connected to a high-tension generator, with the exception that it is not necessary to allow any time for charging or discharging the cable. This is called a "hot" test. The results are the same on testing either leg of the circuit, and the insulation resistance is generally found to be anywhere from 15 per cent to 75 per cent lower when tested "hot" than when the circuit is disconnected from the generator and tested in the ordinary way—that is, "cold"—although the lower the insulation of the circuit, the closer the two tests appear to agree.

When this device was first put into service, and we had convinced ourselves that the readings obtained were really useful, we became impressed with the idea that perhaps we might be able to note the actual effect of the strain of the pressure upon the insulating material surrounding the conductors, and while the results are admittedly too indefinite to be regarded as at all conclusive, they nevertheless point to the fact that the insulation of a circuit does depreciate, for the time being, while under the influence of high potentials.

It has been found by experience that underground circuits, particularly those employed for series arc lighting need periodical overhauling, otherwise weak spots will accumulate to such an extent as to bring down the total insulation resistance below the standard requirements. At such times a great many galvanometer tests are necessary, and it was found that the work could be done much more quickly if the galvanometer were set up in the station instead of being moved from place to place along the street. The great objection to this, however, was the necessity for frequent communication between the foreman of the subway gang and the tester in charge of the galvanometer, obliging the former to use the public telephones a great many times during the day, which was decidedly inconvenient and involved much loss of valuable time. To overcome this serious objection, Mr. Sparrow and his assistant, Mr. L. A. Jenkins, caused to be constructed a special telephone set for use on underground cables, which works very satisfactorily.

The magnetos, instead of being wound, as ordinarily, for 10,000 ohms, are wound to ring through 50,000 ohms, and a battery is placed inside of the magneto box, the transformer and receiver being mounted on a separate L-shaped piece connected by a flexible cord to the magneto-box. The impedance of the series arc circuits, when used for telephoning, is very great, owing to the capacity of the rubber-covered, lead-sheathed cable, and, in order to talk successfully, it was found necessary to use condensers in connection with both telephones. With their use we are able to hold conversation over our longest series arc circuit, which is 12 miles under ground and three miles overhead, and contains 65 lamps. The method is very simple. The telephone at the station end, except at time of test, is left constantly in circuit. When the subway foreman has completed his arrangements for a test he connects his telephone, one wire to the copper of the cable and the other to the lead sheath; calls up the tester and so advises him. The foreman then disconnects his 'phone, and the tester does likewise, at the same time switching in his galvanometer. The latter then makes his test and throws his telephone back into circuit. After the lapse of three minutes the foreman also reconnects his telephone and calls up to know the result of the test and get further instructions. In this way the work of overhauling and renovating is very much facilitated, and the cost of maintenance and repair sensibly reduced.

The other large company distributing two-phase current in this city uses Westinghouse apparatus, and, if I am correctly informed, a variation of the Mershon system of distribution, which is somewhat different from the system just considered. The generators are of the two-phase type, with "star" connection, and generate a potential of 25 times the voltage used on the lamp.

The generator leads, of which there are four, are carried through double-throw switches to the bus-bars, and from these the feeders are taken. The feeders consist of three wires, two being taken from one phase—the red, for instance—and the third, of smaller size, the so-called "power wire," is taken from one of the bus-bars of the other or black-phase. Therefore, on this feeder (No. 1) the lighting is carried on the red-phase and the power taken from both; on the next feeder (No. 2) the lighting is taken from the black-phase and the power from both. In this manner the feeders are balanced between the two sets of bus-bars, so that the load is evenly distributed on the generators.

A large part of the distribution, instead of being made from house-to-house transformers, is accomplished by two large transformers being placed in the vaults or basements of the larger customers, and secondary mains run out from these places to the surrounding installations. The larger of these two transformers carries the lighting load, and is wound with a ratio of 25 to 2, the primary wires being connected to the cables of one phase and the secondary to the two heavy distributing cables having a potential difference of 220 volts. The other or smaller transformer is wound with a ratio of 25 to 4. One of its primary wires is connected to the so-called "power wire" and the other to the center of the primary of the lighting transformer. One of its secondary wires is connected to the secondary "power wire" and the other to one of the secondary lighting wires. You will therefore see that the difference of potential between the secondary leads of this transformer is 220 volts, and that the resultant pressure between the "power wire" and the other lighting cable is 310 volts.

Where incandescent and arc lighting only are required the two lighting cables are carried into the installations and an economy coil placed at the service to divide the pressure into two equal pressures of 110 volts each. Two sizes of coils are used, one of large and special design for theater work and the other for ordinary installations. The leakage loss on the latter varies from .1 to .5 ampere at 200 volts, which goes on during the 24 hours of the day. This probably offsets the saving of leakage loss due to the use of large transformers in substations instead of a greater number of small transformers as in the house-to-house system. Where arc lights are required, the 220-volt wires are carried direct to the lamp and an economy coil used having a ratio of 220 to 32. Where motors are required, the "power wire" is also brought in and the motor connected on the three wires as shown; although as a rule motor customers' premises are used as transformer substations.

Both methods are capable of good work, and, so far as cost of operation is concerned, there is under the existing circumstances but little difference, I think, between the two. It is undoubtedly true, however, that in the matter of power service the Mershon method has a distinct advantage in operating elevator motors of large size, because the primary current is taken, one-half from the lighting circuits and the remainder from the "power wire," whereas in the other method it is taken entirely from the lighting circuits, and the heavy inrush currents at the time the motors start vary the pressure and sometimes produce disagreeable effects upon the lighting, particularly in localities where the copper is scant.

As compared with single-phase distribution either of the two-phase systems above described is superior in two important particulars; viz., (*a*) in the matter of providing a second service, as before stated, and (*b*) in operating elevator motors. The latter point is one of very great importance, as you will appreciate when I say that in New York city there are installed upward of 15,000 horsepower in elevator motors alone, which yield annually a revenue far in excess of what might generally be supposed.

PLEA FOR A WORKING STANDARD OF LIGHT.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, JUNE 27, 1899, BY S. EVERETT DOANE.

It was my desire to present what I am about to say as a part of the discussion on the report of the committee on the standard of light As this committee will not report at this meeting, I bring the following before the institute with no intention, of course, of interfering with the work our committee is doing. We all agree as to the importance of this work. What I wish to propose is that this committee, or a new one, fix definitely the means for maintaining a working standard of light pending the adoption of a primary one.

There are scattered over the country many well equipped laboratories, and in the near future every central station and large isolated plant will be provided with means for measuring light. There is not now in existence any workable primary standard which can be used by the ordinary photometer corps.

It may be said that this is equally true of all primary standards. The mercury column or resistance standard, in fact, presents so many difficulties that it is rarely ever used, even in our best equipped laboratories. In reply we can say that the standard of light differs from all these in that its terms are so indefinite and so crudely outlined that two laboratories can not produce the same value for the candle-power if they work entirely independently. The discussion on this paper will probably bring out very diverse views as to what is the proper direction in which to work to eliminate our present difficulties with the light standard.

The standard of light is in quite another class from the other standards. Every instrument maker is anxious that his instruments shall be calibrated in true units and he can so calibrate them if he uses care. He sends his instruments out so calibrated to the best of his knowledge.

A lamp user may say to the manufacturer, "Your standard is wrong," and neither ever dreams of suggesting a recalibration; they know by experience that an agreement can not be reached. No observer can even duplicate his own work. What is the result? Every lamp maker in the country is sending out some lamps which are wrongly marked according to his own standards because some of his customers have standards of their own.

Lamp makers differ among themselves, and there exists no way by which they can be brought together. It is obviously to the interest of the whole electrical engineering fraternity that some action looking to the correction of this condition be inaugurated.

In passing, I wish to go on record as saying that in a very few years the incandescent lamp will be adopted as a primary standard. It could be so adopted to-day if lamp makers would only tell what they know.

Every committee (our committee included) ever having to do with investigation of proposed light standards has found an incandescent electric lamp a very convenient secondary standard. It has been entirely satisfactory, so much so that my whole purpose in writing this paper has been to see if we can not inaugurate some action which will result in the appointment of a committee who will provide means whereby a standard of light may be arbitrarily maintained. This committee could send out, under proper restrictions, properly seasoned and calibrated incandescent lamps for this purpose.

It does not matter just how this is done. Possibly a national laboratory could be founded. A committee of the professors of electrical engineering from our various colleges might agree to do this for us. Something should be done, and the first step toward it will be the appointment of an institute committee on the maintenance of what our committee on light may decide is a proper standard value. Such a decision will be arbitrary and may have to be changed later; but what of that? We need now a common working standard of light.

That the discussion may be entirely free I refrain from making any definite suggestions until the views of the members may be obtained, but whatever these views may prove to be, I hope some action will be taken which will afford us temporary relief, and enable our committee on light standard to pursue its work unhindered by the necessity of hasty action. We can take action none too soon. A year from now, at the rate photometers are being made, we shall have as many standards of light as Joseph's coat had colors, unless something be done.

An electric fountain will be placed in Clinton Square, at Syracuse, N .Y.

LATE NEWS.

The stockholders of the Third Avenue Railroad Company, of New York city, will meet on July 19 to vote on a proposition to increase the capital of the company from $12,000,000 to $40,000,000.

President Rossiter, of the Brooklyn, N. Y., Rapid Transit Company, expects that the electrical equipment of the Fifth avenue branch of the Union elevated road will be completed by the end of this week.

Work has begun on the new line of electric railroad which will extend from Bethel, Vt., through the towns of Bethel, Stockbridge, Pittsfield and Rochester, a distance of 18 miles. The road will be known as the Bethel & Rochester Electric Railroad.

The Amsterdam Electric Light and Power Company, of Brooklyn, N. Y., has been purchased by a syndicate representing the Kings County Electric Light and Power Company, thus giving the latter company complete control of the electric lighting business of Brooklyn.

Superintendent Partridge, of the New York State Department of Public Works, has granted the application of the Hudson River Power Transmission Company for permission to erect poles and string wires on the berm-bank of the canal between Mechanicville and Albany, a distance of 20 miles.

The scheme for the municipal ownership of the street-railway lines in Detroit was quietly squelched in the Common Council on June 27. The matter came up on a report of the special committee to which had been referred the granting of the franchise necessary to accomplish the purpose of the commission. The report was against granting any franchises without a special election, and the committee said that there was now no way in which such an election could be legally held. The report was laid on the table.

Articles of consolidation of the Utica Electric Light Company, the Utica Electrical Manufacturing and Supply Company, and the Trenton Falls Electric Light and Power Company, forming the Utica Electric Light and Power Company, to operate in the cities of Utica and Rome, N. Y., and in Oneida and Herkimer counties, were filed on June 27. The capital is $1,000,000, and the directors are Joseph Fox, of New York; William G. Phelps, of Binghamton, and Henry D. Pixley, Daniel N. Crouse, T. S. Griffiths, M. J. Brayton and William E. Lewis, of Utica.

Electricity in Southern Hotels.

The Westinghouse Machine Company, of East Pittsburgh, Pa., have originated a novel method of supplying electric light and power for hotels. A combination of a Westinghouse gas engine with a Westinghouse electric generator is peculiarly adapted for use in lighting public and private buildings. Several large hotels have recently been furnished with outfits by Messrs. Westinghouse, Church, Kerr & Company, New York, among them being the Florida East Coast Hotel System, who have placed a Westinghouse gas engine and electric generator in their hotels at Nassau, British West Indies, and at Ormond, Fla. These plants have been in operation for several months, and are working so efficiently that the same company have now ordered an equipment for the Royal Palm, a new hotel building at Miami, Fla. A 65-horse-power Westinghouse gas engine and generator will be provided. All three engines use gasoline for fuel. These gas engines, it is claimed, are free from odor, noiseless and cleanly. They can be placed in a basement, where a steam plant, with its dirt and escaping heat, would be objectionable.

Air as a Motive Power.

The persistent booming of the stock of the International Air Power Company through the press is not encouraging to those who do not like to see useful mechanical agencies employed to fool the public and trap the unwary. The scheme of using air as a motive power for vehicles may have been honestly conceived, but there is nothing less promissory of success. Compressed air has a wide and useful field in the mine, the shop, the quarry and the shipyard, but it is not adapted to transportation, not even on a steel track, in our opinion. If it can not compete with steam and the trolley on a track, how can it compete with the horse on the pavement?—*The Engineer.*

A Reminder of Independence Day.

The John A. Roebling's Sons Company, of New York city, the well known manufacturers of cables and wires, through Mr. Henry L. Shippy, treasurer, is sending to its friends a beautifully prepared fac-simile of the Declaration of Independence, as a reminder of Independence Day. The cover of the brochure is printed in three colors, and is a tasteful work of art. A noticeable feature of the booklet is that there is absolutely no advertising in it.

MOTOR SPEED REGULATION.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, JUNE 26, 1899, BY ALTON D. ADAMS.

While great advances have been made in the application of alternating machinery, the distribution of power by direct currents was probably never increasing faster than to-day.

Tens of thousands of horse-power are now delivered by direct-current motors, and a large part of this work is done at variable speed.

In spite of this extended use, the direct-current motor, as commonly used for variable speed, is by far the least efficient link between the central station engine and the consumer's machinery.

This lack of efficiency is by no means inherent in the motor, but results from the common method of speed regulation by the use of a variable resistance in the armature circuit.

As the case now stands the central station furnishes about 80 per cent of the power developed by its engines to consumers. Manufacturers provide motors of from 80 to 90 per cent efficiency at full speed and load, and the user in order to regulate the speed to his requirements commonly employs a method of regulation which reduces the efficiency of his motor to 50, 25 or even 10 per cent.

Consider for example a motor having an efficiency of 86 per cent at full load and speed, with losses of three per cent in armature windings, three per cent in shunt magnet winding and eight per cent local currents, friction and hysteresis.

Let this motor be loaded to full and constant armature current and then regulated for variable speed by a resistance in the armature circuit.

As the energy entering the armature circuit is 97 per cent of that drawn from the line and the loss in armature winding is three per cent of the total, this winding loss is $.03 \div .97 = 3.09$ per cent of the energy entering the armature circuit.

The pressure required to force the full current through the armature resistance is therefore 3.09 per cent of the line pressure.

The counter electromotive force of the armature at full speed will be $100 - 3.09 = 96.91$ per cent of the line pressure, and at one-fourth speed the counter electromotive force will be $96.94 \div 4 = 24.22$ per cent of the line pressure.

At quarter speed, then, the rheostat in armature circuit must consume $100 - (3.09 + 24.22) = 72.69$ of the line pressure, and as 97 per cent of the total energy is delivered to this circuit, the rheostat in this case consumes $97 + .7269 = 70.5$ per cent of the energy taken from the line.

Assuming that the losses from local currents, hysteresis and friction vary directly with the speed, the losses internal to the motor at one-quarter speed, became $(8 \div 4) + 3 + 3 = 8$ per cent, and the total losses in motor and regulator became $70.5 + 8 = 78.5$ per cent, thus giving the combination an efficiency of $100 - 78.5 = 21.5$ per cent at one-quarter speed.

At less than constant torque and armature current, the combined efficiency will evidently be lower than above figures.

As there are well known methods of speed regulation which involve only the small losses internal to motors, whatever the speed, it seems that a stronger effort on the part of manufacturers to introduce machines with efficient means of speed regulation, would benefit all concerned.

Two practical methods of motor speed regulation are the variation of magnet strength, and the variation in arrangement of armature conductors as to each other.

A rheostat in the shunt magnet winding gives any desired speed above the minimum, with constant armature capacity, and two or more separate windings and commutators on the armature, give two, three or four times the minimum speed, with corresponding increase in armature current capacity.

The work required of variable speed motors is of three kinds; namely, constant whatever the speed, varying directly as the speed, and varying directly as some power of the speed. These three classes of work are illustrated by machine tools, which require, when in use, nearly constant power for all speeds, by shafting which consumes power nearly as its speed, and by centrifugal fans whose driving power varies as the cube of their speeds, friction aside.

As constant power at all speeds involves a constant armature current, it is well provided for by a variable magnet strength to correspond with all desired speeds, but special proportions are necessary to avoid sparking with a constant armature reaction and weak magnets at the higher speeds.

When the required power and consequently armature current varies directly with the speed, the armature reaction, winding loss and magnet strength may be held constant and the desired speeds secured through two or more separate windings and commutators, provided a reduction of the maximum speed to one-half or one-fourth is sufficient.

If the power and armature current must vary as the cube or other high power of the speed it is well to combine the method of multiple armature windings with the variation of magnet strength, as the variation of armature conductors which gives the desired speed does not in this case afford proper current capacity.

It is certain that motors constructed far above methods of speed regulation will cost more than those of ordinary type, whose speed can only be regulated by a resistance in the armature circuit.

It is equally certain that the saving of energy effected by the more efficient means of speed regulation will soon offset its increased cost in any given case.

Efficient means of regulation in variable speed motors will benefit manufacturers through the sale of more valuable machines, the consumer by a reduction in power bills, and central stations and manufacturers alike in the increased use that a large reduction in the cost of operation will produce.

Attention is called to these facts, not because they are new but because their importance entitles them to more consideration than they have received.

A New Electrical Supply House in New York City.

Last week the spacious quarters of the Columbia Electrical Supply Company, at 93 Liberty street, New York city, were opened officially to the electrical fraternity. An elaborate luncheon was served to the many visitors who were present from New York, Boston, Philadelphia and elsewhere.

The new company is the agent for the General Electric Company and for Edison lamps for New York city. A complete stock of electric light and house goods supplies, as well as a number of meritorious specialties, is carried.

The officers of the company are Messrs. T. M. R. Meikleham, president; J. Sheafe Douglas, treasurer; W. B. Dinsmore, Jr., secretary, and H. Percy Douglas, vice-president. Mr. J. C. Moulton is store manager.

The ELECTRICAL REVIEW extends a cordial welcome to the Columbia Electrical Supply Company and believes it will achieve a full measure of success.

Wall Street and the Electrical Stock Market.

The most striking feature of the week in the stock market was the weather reports from the West and northwest indicating good crops of corn and Spring wheat. This gave firmness to the granger shares and to the stocks of western railroads. The outlook for railway securities is very encouraging. The money market has been easy, and trade returns from all over the country make splendid showings.

On the New York Stock Exchange General Electric closed the week at 117¼ bid and 118 asked, a rise of ¼ point in the bid price for the week. Metropolitan Street Railway of New York closed at 228¾ bid and 229 asked, a gain of 2½ points for the week. Third Avenue Railroad of New York closed at 192 bid and 195 asked, a loss of 5 points for the week.

On the Boston exchange American Bell Telephone closed at 343 bid and 350 asked. Erie Telephone closed at 95⅛ bid and 96 asked.

On the Philadelphia exchange Electric Storage Battery common closed at 125 bid and 130 asked, a loss of 7 points for the week. Union Traction closed at 41⅝ bid and 41⅞ asked, a gain of ⅝ of a point for the week.

It is stated that the Electric Company of America, Philadelphia, is to begin regular dividends on the stock July 1. This company owns some valuable electric lighting properties, is strongly held and conservatively managed.

On the curb or outside market in New York Electric Vehicle closed at 100 bid and 102 asked, ex-dividend, a loss of 8 points for the week. Electric Boat closed at 18 bid and 22 asked, a loss of 2 points for the week.

Wall Street, June 24.

Storage Battery Injunctions.

On June 14, 1899, Judge Colt, in the United States Circuit Court, at Boston, Mass., granted a preliminary injunction on complaint of the Electric Storage Battery Company, of Philadelphia, Pa., against the Quincy & Boston Street Railway Company, restraining the latter from using and operating the elements of the Hatch storage battery installed at South Braintree, Mass., and used as an auxiliary to the trolley system. It is held that the Hatch battery infringes upon the well known Brush patents owned by the Electric Storage Battery Company. This injunction becomes effective on August 1, as the railway company was given until that time to remove the infringing batteries. This is one of several suits which are the outgrowth of that in which a preliminary injunction was granted against the Hatch Storage Battery Company, on May 5 last.

ADVANCE INFORMATION

New Electric Railways.

DOVER, DEL.—A certificate of incorporation has been issued by the Secretary of State to the Beacon Motor Traction Company, of Boston, Mass.; capital stock, $1,000,000.

GRAND RAPIDS, MICH.—The Grand Rapids, Holland & Lake Michigan Electric Railroad Company has been incorporated. The company has $100,000 capital stock, and will build an electric road from here to Holland, a distance of 35 miles.

NATICK, MASS.—The Natick & Needham Street Railway Company is being incorporated, to operate a proposed street railway from the terminus of the South Middlesex Street Railway Company, at South Natick, through the towns of Natick and Dover to the New York, New Haven & Hartford railroad depot in Needham. The length of the road will be about six miles, and the capital of the company has been fixed at $50,000. The incorporators are W. B. Ferguson, Geo. A. Butman and A. W. Clapp, of Malden; Harvey A. Whitney, S. A. Sweetland, J. M. Fiske and Francis Bigelow, of Natick; James J. Valentine, of Framingham; James F. Shaw, of Newburyport; J. H. Cunningham, of Chelsea; Chas. Goss, of Amesbury; Frank E. Lowe, of Greenfield; Charles E. Dresser, of Leominster; John L. Twigg and Arthur Whitaker, of Needham. The temporary directors are W. B. Ferguson, Francis Bigelow, Harvey H. Whitney, Geo. A. Butman, John H. Cunningham, John L. Twigg and Arthur Whitaker.

CLEVELAND, OHIO — The Cleveland & Eastern Railway Company has been incorporated by H. Clark Ford, Harrison S. McGrew, John Wilson Hart, Frederick A Henry and S. P. Baldwin, with $1,000,000 capital stock. Cleveland and Burton are to be the termini, and branches are to extend from Fullertown to Chardon. Side tracks, etc., are also to be constructed. The road is to be operated by electricity, and to carry passengers, freight, mail and express.

MORRISTOWN, N. J.—The Morris County Traction Company has been organized, with a capital stock of $250,000, with which it proposes to begin the construction of a trolley road in Morris County. Robert D. Foote, vice-president of the National Iron Bank, of Morristown; John H. Capstick, a wealthy manufacturer of Montville and the president of a bank in Boonton, and George W. Stickle, a capitalist, living in Rockaway, are named as incorporators.

SPRINGFIELD, OHIO—The Springfield, Columbus & Zanesville Electric Railway Company has been incorporated. Springfield and Zanesville will be the termini of the new road, and it will pass through the counties of Clark, Madison, Franklin, Licking and Muskingum. The company's headquarters will be established at Columbus, and the incorporators are J. A. Mehling, A. T. Seymour, W. H. Jones, D. T. Keating and S. W. Hubbard. The capital stock is placed at $10,000.

ASHLAND, PA.—Ashland & Centralia Electric Railway Company has been incorporated to build a line between Ashland and Centralia. The company is capitalized at $50,000.

MINNEAPOLIS, MINN.—The Minneapolis & St. Paul Suburban Railway Company has been incorporated, the capital stock being $1,300,000, and the incorporators named as follows: Thomas Lowry, Calvin G. Goodrich, M. B. Koon, J. F. Calderwood, of Minneapolis, and Marcus D. Munn, of St. Paul.

TRENTON, N. J.—The Morris County Traction Company has been incorporated with a capital of $250,000.

HUNTSVILLE, ALA.—The Huntsville Electric Street Railway Company; capital, $100,000. T. C. Dupont, the powder magnate, is said to be interested. The Company has secured a city charter, and agreed to begin work within 30 days and have from five to six miles of track in operation at the expiration of 12 months. The main line will connect West Huntsville with East Huntsville by a direct route through the city.

Electric Light and Power.

CONNERSVILLE, IND.—The Connersville Gas and Electric Company has been reorganized, with a capital stock of $75,000, to be known as the Connersville Gas, Electric and Power Company.

TIFFIN, OHIO—The Tiffin Light and Fuel Company has been incorporated to construct and operate electric light and gas plants; capital, $50,000; incorporators, F. I. Isbell, C. H. Lemmon, W. J. Gill, E. P. Simon, all of Tiffin.

MANKATO, MINN.—The Mankato Street Railway, Lighting and Power Company has been incorporated. The capital stock is placed at $500,000.

New Incorporations.

SAN FRANCISCO, CAL.—The Tehama Electric Company has been incorporated; capital stock, $50,000; incorporators, J. Cross, G. F. Hanson, M. F. Michael, C. W. Willard, A. H. Winn, all of San Francisco.

JERSEY CITY, N. J. — The E. Howard Power and Clock Company, to carry on business of an electric light company, has been incorporated; capital, $1,000,000; incorporators, Alfred Ely, William H. Carey, Edward A. Freshman, all of Jersey City.

PORTLAND, ME.—New Era Electric Protection Company, with $100,000 capital stock. The directors are: James H. Clark and George H. Clark, of Boston, Mass.; George W. Mason, of East Cambridge, Mass.; Geo. D. Kemp, of Dorchester, Mass., and Philip J. Larrabee, of Portland. The president is James H. Clark, the treasurer is George H. Clark, and the clerk is Philip J. Larrabee.

PORTLAND, ME. — The Runnells Car Fender Company has been organized to manufacture a car fender, with $100,000 capital stock, of which $15 is paid in. The officers are: President, H. B. Russ, of Portland; treasurer, Eugene W. Hunt, of Portland.

TRENTON, N. J.—The Ascot Vehicle Company has been incorporated to manufacture electric vehicles; capital, $100,000.

CHICAGO TRADE NOTES.

The Osburn Electric Manufacturing Company, of 294 Dearborn street, Chicago, say that those intending to purchase a quantity of incandescent lamps will find it to their interest to consult them before doing so. They have lately bought the entire stock of the National Incandescent Lamp Company, and are naming very attractive prices to the trade.

The Sterling Electric Company, of 71–73 West Adams street, Chicago, have recently made several changes in their factory, and are getting into better shape to handle their constantly increasing business. Mr. Doolittle, the general manager, states they will soon be ready to put some new Sterling Bell telephone specialties on the market, and that their business now compels them, and has for sometime past, to work a day and night force.

The Hart & Hegeman Manufacturing Company, through its agent George S. Sewring, says: "We are finding the same active demand for Hart & Hegeman switches. The Hart H. & H. push switch meets with universal favor, and it is as well made as it is possible to make a switch. No detail of design, workmanship or material is omitted, and we have found this, as well as all our other makes, to give the best of satisfaction."

The National Automatic Telephone Co., of Chicago, and Salina, Kas., have lately installed exchanges at the following towns: St. Mary's, Wamego and Anthony, Kas.; Ashland, Eureka, Rankin and Geneva, Ill., and Buena Vista, Cal. A complete interior system was also installed in the new headquarters building of the Modern Woodmen of America, at Rock Island, Ill. They report a very good business, and claim their system is most satisfactory in every case.

Mr. C. S. Knight, of the Siemens & Halske Company of America, and the Illinois Electric Vehicle Company, has been kept extremely busy of late attending to the affairs of the two above named corporations. The factory of the Siemens & Halske Company, in Chicago, has been undergoing extensive repairs and has been greatly increased in manufacturing capacity by the addition of a lot of new machinery. This will enable them to take care of the immense amount of business they expect to handle. F. E. C.

BOOK REVIEWS.

"Mechanical Movements, Powers, Devices and Appliances," by Gardner D. Hiscox, M. E. New York: Norman W. Henley & Company.

This is a most extraordinary book, consisting almost entirely of illustrations to which are appended short descriptions of a large variety of mechanical movements and appliances. There are 1,650 illustrations in the 400 pages of the text. For mechanics, draughtsmen, engineers, and especially of inventors (who will find that most of the movements and devices they think are new are already described in this book), the work will be found of much use. Mr. Hiscox is to be congratulated upon the completion of so ingenious and valuable a book.

"Leçons sur l'Électricité," by Prof. Eric Gerard. Paris: Gauthier-Villars et Fils, Publishers.

This is the sixth edition of this important and admirable work. The principal changes to be noted are the application of the theory of ions to the study of electrolysis, batteries and accumulators, and a broadening of the mathematical treatment of alternating currents. It is to be regretted that MM. Gauthier-Villars have not in this edition entirely relieved Professor Gerard's work of the reproach of bad printing, which has been so noticeable in former editions. There has been some attempt made to better the presswork and illustrations, but neither is up to the standard.

"I can see but one policy to pursue," writes Worthington C. Ford in the July issue of *Harper's Magazine*, "that of free trade in the Philippines, permitting the islands to find their place under the full stress of competition. In Puerto Rico a tariff for revenue only and the free entry of its products into American markets. The question of Hawaii has settled itself—free trade. The example of a corrupt use of tariff legislation should not be extended to the new possessions." Mr. Ford sustains his conclusion in a remarkable and convincing way, and his article is full of valuable information presented in admirable manner.

Leslie's Weekly, which depicted the vital incidents of the Spanish-American war with wonderful promptness and accuracy, is maintaining the high degree of excellence it then achieved. Current events in all parts of the world are chronicled pictorially almost as they occur. The staunch Americanism which has always characterized *Leslie's Weekly* makes it a doubly welcomed visitor in American homes. It is one of the best illustrated publications in the world.

OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES

ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. XXXIV.—No. 1. NEW YORK, WEDNESDAY, JANUARY 4, 1899. TEN CENTS A COPY. THREE DOLLARS A YEAR.

Copyright, 1899, by ELECTRICAL REVIEW PUB. CO.

THE PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC GLOBES, SHADES, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE? IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

ELECTRIC LIGHTING AND POWER APPARATUS
MANUFACTURED BY
THE EDDY ELECTRIC MANUFACTURING CO.,
WINDSOR, CONN.
NEW YORK OFFICE, 143 LIBERTY STREET.

CRESCENT SHADE.

2¼x10 inches. The BEST tin shade on the market at a less price than is being charged for the WORST.
ELECTRIC APPLIANCE COMPANY,
Electrical Supplies,
242 Madison St., CHICAGO.

N. I. R.
WIRES and CABLES.
NATIONAL INDIA RUBBER CO.
FACTORY AND GENERAL OFFICES, BRISTOL, R. I.

THE BRISTOL COMPANY
WATERBURY, CONN.

RECORDING VOLTMETERS,
RECORDING AMPEREMETERS,
RECORDING WATTMETERS,
RECORDING PRESSURE GAUGES,
RECORDING THERMOMETERS,
PAY FOR THEMSELVES.
SEND FOR CATALOGUE.

CROCKER-WHEELER
Direct-current Dynamos, Motors and Dynamotors.
Main Office: 39 Cortlandt St. New York.
Works: Ampere, Newark, N. J.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Mgrs.
GEO. T. MANSON, Gen. Supt. W. H. HODGINS, Secy.

1889 PARIS EXPOSITION MEDAL FOR RUBBER INSULATION.

OKONITE
TRADE MARK

1893 WORLD'S FAIR MEDAL FOR RUBBER INSULATION

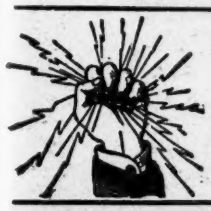
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES. Write for Prices.
THE OKONITE CO., Ltd., 253 Broadway, New York.

NATIONAL CONDUIT & CABLE COMPANY,
Manufacturers and Patentees of
PAPER INSULATED CABLES and WROUGHT-IRON CEMENT-LINED PIPES for UNDERGROUND SUBWAYS.
73,000,000 Feet of Our Conduit and Thousands of Miles of Our Cables in Use in United States, Canada and the British Isles.
MAIN OFFICE: TIMES BUILDING, NEW YORK.
Branches: { Rookery, Chicago, Ill. / Ames B'ld'g, Boston, Mass.

NAME PLATES FOR MACHINERY AND MOTORS
VOLTS AMP.
SOUVENIR BY MAIL.
The Becker Name-Plate Co.
34 Oliver Street, BOSTON, MASS.
Makers of switchboard, motor, arc-lamp, telephone and machinery NAME-PLATES. Dies for printing on wood, etc. Also steam type and embossing plates for all purposes. Send for estimate.

EXPERT CHEMISTS
Specialists in Armature and Field Coil Insulation
MASSACHUSETTS CHEMICAL CO.,
BOSTON, Mass., ...U. S. A.

KOCH Dynamo Brush
Goldmark & Wallace
Agents for U. S. 123 Worth St., New York.



AMERICAN ELECTRICAL WORKS
PROVIDENCE, R. I.
Bare and Insulated Electric Wire.

STANDARD UNDERGROUND CABLE COMPANY,
Westinghouse Bldg., Pittsburgh, Pa.
18 Cortlandt Street, New York.
1235 Betz Building, Philadelphia, Pa.
542 The Rookery, Chicago, Ill.
507 Security Bldg., St. Louis, Mo.
FIBER PAPER RUBBER ELECTRIC CABLES,
CEMENT BRICK TILE WOOD CONDUITS.
HIGH-GRADE RUBBER COVERED AND WEATHERPROOF WIRES.
TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER.

GRIMSHAW WHITE CORE WIRES,
RAVEN WHITE CORE WIRES,
RAVEN BLACK CORE WIRES,
COMPETITION LINE WIRES,
GRIMSHAW and COMPETITION TAPES and SPLICING COMPOUNDS.
BRANCHES:
CHICAGO, 320 Dearborn Street.
BOSTON, 134 Congress Street.
SAN FRANCISCO, 71 Flood Building.
Manufactured by NEW YORK INSULATED WIRE COMPANY,
Main Office, 13-15-17 Cortlandt Street, New York.

COLUMBIA INCANDESCENT LAMPS.
UNEQUALED IN QUALITY
Columbia Incandescent Lamp Co.,
ST. LOUIS, MO.
NEW YORK OFFICE, 1311 HAVEMEYER BUILDING.

"PEGAMOID" Trade-Mark
ENAMELETTE.
A waterproof composition not affected by petroleum, kerosene, benzine, turpentine, linseed, cottonseed or caster oils, salt air, water or atmospheric influences. Unequaled for tanks, barrels, tunnels, machinery in damp places, hulls of vessels, cottages near the ocean, interior work and decoration. In all colors. Sample by mail for 25 cents.
THE AMERICAN PEGAMOID CO.,
346 BROADWAY, N. Y.

J. H. Bunnell & Co.
76 CORTLANDT ST.,
NEW YORK.

WHEELOCK BATTERY. WITHOUT AN EQUAL for FANS and ALL MOTORS. Does not polarize under heavy work. Send for Circular.
DRY BATTERIES BEST OF ALL IS THE "MASCOT."
Best Construction and Ingredients, Strongest, Most Durable and Reliable. Size, 6 x 3¼. 50 cents per cell. Liberal Discount

CREFELD ELECTRICAL WORKS
WIRES AND CABLES,
49 Federal Street, BOSTON.

American Vitrified Conduit Co.
VITRIFIED GLAZED CONDUITS.
UNDERGROUND CONDUIT SYSTEMS.
General Office, 39-41 Cortlandt St., NEW YORK.
C. J. Field, Gen. Man. and Chief Engineer.

SIMPLEX WIRES AND CABLES
FOR UNDERGROUND SUBMARINE LINE AND INSIDE CONSTRUCTION
SIMPLEX ELECTRICAL CO
75 BICKNHILL BOSTON 1170 MONADNOCK BLOCK CHICAGO

"COLUMBIA"

WE CLAIM, AND ALSO GUARANTEE, THAT COLUMBIA LAMPS ARE UNEQUALED IN QUALITY.

BECAUSE THEY ARE ABSOLUTELY UNIFORM IN VOLTAGE.
BECAUSE THEY ARE ABSOLUTELY UNIFORM IN CANDLE POWER.
BECAUSE THEY ARE ABSOLUTELY UNIFORM IN CONSUMPTION OF ENERGY. BECAUSE THEIR AVERAGE LIFE WILL BE FOUND ENTIRELY SATISFACTORY.

WITH THE ABOVE GUARANTEE, WE RESPECTFULLY SOLICIT ORDERS OF ALL CENTRAL STATIONS AND ISOLATED PLANTS.

SPECIAL PRICES ON ANNUAL CONTRACTS WHERE THE ANNUAL REQUIREMENT EQUAL OR EXCEED 1000 LAMPS.

LAMPS IN STOCK AT BRANCH OFFICES, AS WELL AS FACTORY, INSURING PROMPT SHIPMENTS.

The COLUMBIA INCANDESCENT LAMP CO.

MAIN OFFICE AND FACTORY:
1910-1912-1914 OLIVE STREET, ST. LOUIS, MO.

BRANCH OFFICES.
NEW YORK 1311 HAVEMEYER BLDG.
CHICAGO 1236 MONADNOCK BLDG.
SAN FRANCISCO, PAUL SEILER ELECTRICAL WORKS.

For Holidays

We have a very complete line of **Miniature Lamps** for decorating use, in clear and natural color glass, and in all standard shapes, candle-power and voltage; we are also introducing a new lamp which we call "Type 6" which is but 1⅞ inches in diameter and 3⅝ inches long, operating on circuits of from 90 to 130 volts; any standard base; 4 and 6 candle-power; for sign or decorative use. Send for our latest prices

GEO. A. McKINLOCK, President.
CHAS. E. BROWN, Secretary.
S. R. FRAZIER, Treasurer.

OKONITE TRADE MARK.

Central Electric Company
264-266-268-270 Fifth Avenue, CHICAGO.

SOLID CARBONS FOR SERIES LIGHTING.
SELF-LUBRICATING MOTOR BRUSHES.
BATTERY CUPS AND PLATES.

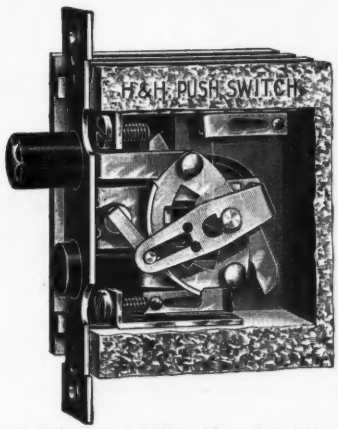
HELIOS CARBONS FOR ENCLOSED ARC LAMPS

ALTERNATING CURRENT CORED CARBONS.
DIRECT CURRENT CORED AND SOLID CARBONS.

THE WASHINGTON CARBON CO.

NEW YORK 751 BOWLING GREEN BLDG. PITTSBURGH PA. BOSTON 524 TREMONT BLDG.

HART H. & H. PUSH SWITCH.



No. 702 (10 amp. D. P.), without face plate.

The **EASE** with which this switch can be operated, combined with many other good points, makes it a favorite with electrical engineers and electrical workers everywhere.

Sold by all Electrical Supply Houses.

THE HART & HEGEMAN MFG. CO.,
108 High Street, - - HARTFORD, CONN.

ENCLOSED ARC LAMPS.

THE
UPTON "MIDGET"

FOR LOW-TENSION, CONSTANT-POTENTIAL CURRENT.
110 Volts. 3 to 6 Amperes. 150 Hours.

FOR HIGH-TENSION, SERIES CIRCUITS.
4 to 7 Amperes. 125 Hours.

FOR ALTERNATING CURRENT.
6,000 to 16,000 Alternations. 125 Hours. Noiseless.

FOR 220 or 500-VOLT CIRCUITS, TWO OR FIVE IN SERIES.
3 to 5 Amperes. 125 to 150 Hours. Automatic Switch.

FOR 220-VOLT CIRCUITS, TO BURN SINGLY.
150 to 160 Volts at arc. 2½ Amperes.
125 to 150 Hours.

BEST IN THE MARKET!
Absolutely Steady White Light!

No. 215.

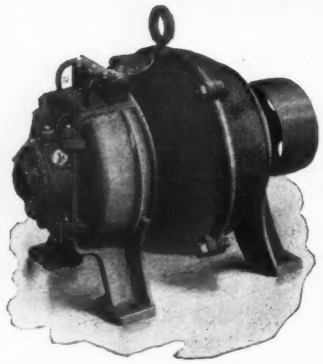
NO PARTS TO WEAR OR GET OUT OF ORDER!

THE UPTON OPEN ARC FOR ALL CIRCUITS.

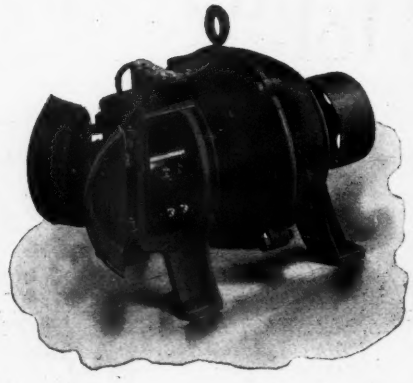
Send for Catalogues Nos. 31 and 33.

STANDARD THERMOMETER AND ELECTRIC CO.,
PEABODY, MASS.

AGENCIES: New York, Philadelphia, Chicago, New Orleans, San Francisco, Montreal, London, England.



A Lundell Motor takes up very little space, usually none outside of the space already occupied by the machine you want to operate. One advantage of using electric motors is that you can start or stop or reverse any machine absolutely independent of every other machine, running fast or slow as desired. **No power is being consumed except right where you are doing work.** No technical knowledge of electrical machinery is necessary to operate **Lundell Motors.** They are simple, compact and substantially constructed. They require no repairs and need no attention except to keep the oil wells filled. If you are running a large establishment every machine offers an opportunity for economy in the advantageous use of an electric motor. If you are only operating a few machines you can do it **better, cheaper and safer** with **Lundell Motors** than with any other power. We will be glad to have you write and allow us to explain how we can help you in your work.



We make these motors for belted, direct, or geared connection to any machine; sizes from one-quarter h.-p. up. **Economy and Durability Guaranteed.**

All correspondence promptly and carefully answered. Write for Catalogue No. 586.

SPRAGUE ELECTRIC COMPANY,

Chicago, Marquette Building.

20 BROAD STREET, NEW YORK.

Fan Motors. Interior Conduits.

BUCKEYE INCANDESCENT LAMPS

QUALITY UNEQUALED. FACTORY PRODUCTION TRIPLED.

THE BUCKEYE ELECTRIC CO.,

Monadnock Building, Chicago. - - - - Cleveland, Ohio.

W. C. YOUNG MFG. CO.

MANFRS. & EXPORTERS OF

LATHES, PUNCHES AND SHEARS.

TELEGRAPH ADDRESS YOUNG, WORCESTER. WESTERN UNION CODE USED.

WORCESTER, MASS., U.S.A.

EUROPEAN AGENCIES:

SELIG SONNENTHAL & Co., London. | E. SONNENTHAL, Jr., Berlin.

H. W. PEABODY & Co., Paris. | JOSEF SCHWARCZ, Budapest.

Porcelain Manufactory.

EMPIRE CHINA WORKS,

144-156 Greene Street, Station C,

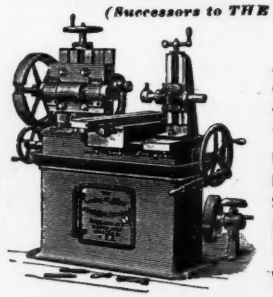
BROOKLYN, N. Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS, Etc.

THE AMERICAN TOOL WORKS CO.

(Successors to THE DAVIS & EGAN MACHINE TOOL CO.)

Designers and Builders



IMPROVED MACHINE SHOP EQUIPMENTS.

LATHES, PLANERS, BORING MILLS, SHAPERS, UPRIGHT AND RADIAL DRILLS, MILLING MACHINES, SCREW MACHINES, BRASS WORKING TOOLS, PUNCHES AND SHEARS, BOLT CUTTERS, PULLEY LATHES, SHAFTING LATHES, ETC.

Works: **CINCINNATI, OHIO, U. S. A.**

NEW YORK: 107 Liberty Street. | CHICAGO: 68 South Canal Street. | BOSTON: 86 Federal Street. | PHILADELPHIA: 19 North Seventh Street.

Star ★ Lathes

Foot power Screw... ...cutting Automatic Cross feed

9 and 11-inch Swing.

New and Original Features

Send for Catalogue B.

Seneca Falls Mfg. Company, 480 Water St., Seneca Falls, N.Y.

Central Manufacturing Co.

Chattanooga, Tenn.

Manufacturers and Dealers in

Yellow Pine Cross Arms, Locust Pins.

Oak Pins, Electrical Mouldings, Oak Brackets

Large stocks on hand. Delivered prices quoted, F. O. B. cars, your city, in any quantity. ☞ Write us.

WESTERN ELECTRIC

..ARC..

LIGHTING DYNAMOS.

SIZES FROM

50 light to 150 light, capacity 9.6 amperes. 85 to 180 light, capacity 6 amperes.

SEND FOR BULLETIN 1002.

WESTERN ELECTRIC COMPANY,

CHICAGO.

NEW YORK.

LONDON, 79 Coleman Street.
ANTWERP, 33 Rue Boudewyns.
PARIS, 45 Avenue de Breteuil.

Up-to-Date Managers Appreciate Them.....

OUR GENUINE PORCELAIN ENAMEL DEFLECTOR, No. 466

For Incandescent Street Fixture. Fits 14-inch Hood, our No. 663

No. 663.

No. 466.

Genuine Porcelain Enamel on Heavy Iron

PRACTICALLY INDESTRUCTIBLE

PERMANENTLY EFFICIENT

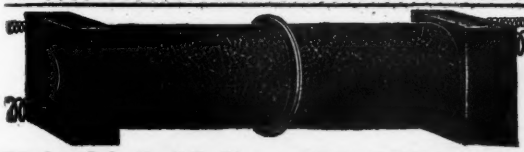
REFLECTORS AND SHADES FOR EVERY PURPOSE

Manufacturers' Prices Prompt Shipments

WHEELER REFLECTOR CO.,

Boston, Mass.

The Largest Reflector Manufacturers in the World.



Magnets

Telephone Induction Coils, Ringer and Bridge Bell Magnets, Drop Magnets, etc., etc., also

GAS LIGHTING SPARK COILS,

THE VARLEY DUPLEX MAGNET CO., 138 Seventh Street, Jersey City, N. J.

THE "CLARK" WIRE

FOR SWITCHBOARD, RAILWAY AND MOTOR USE.

All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public, and in use for the past 10 years, and has met with universal favor. We guarantee our insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treasurer and General Manager. HERBERT H. EUSTIS, President and Electrician. 61-63 Hampshire St., BOSTON, MASS

WATER WHEELS

For Heads of 3 Feet to 2000 Feet.

Especially adapted to all kinds of

ELECTRIC POWER AND LIGHTING PLANTS.

Recent tests at Holyoke, given below, enable us to guarantee: *The Largest Power ever obtained from a wheel of the same diameter. The highest speed ever obtained for the same power. The highest mean efficiency when running from half to full gate.* We guarantee also: *A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing*

Test of a 45 in. SAMSON, Jan. 25, 97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03
⅞	15.04	138.12	155.03	223.61	84 55
¾	15.11	127.67	133.24	191.06	83.58
⅝	15.88	131.50	112.65	162.80	80 25
½	16.47	126.87	90.04	127.73	75.95

Test of a 35 inch SAMSON, Feb.1, '97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.29	194 25	102.02	143.44	81.08
⅞	16.56	187.75	92.13	146.73	84.78
¾	17.33	178.50	83.95	138.40	83.88
⅝	17.54	176.40	68.82	109.64	80.09
½	17.68	168.50	57.69	88.14	76.19

JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

Sparkling Novelty

NEW STANDARD ELECTRIC NECKTIE PIN

AN OFFER

To celebrate the most successful first year in the history of dry-cell manufacturing, we will send post-paid for $1.00, anywhere, above outfit, the smallest lamp ever made, that will light; operated with new Standard No. 4 Vest-Pocket Cell. The most powerful dry-cell of its size ever constructed.

THE NEW STANDARD DRY-CELLS ARE MADE IN ANY SIZE WHATSOEVER AND WILL OUTCLASS AND OUTLAST ALL OTHERS.

Very Liberal Discount to Trade and Jobbers

William Roche

Inventor and Sole Manufacturer

259 GREENWICH STREET, NEW YORK

GLASS INSULATORS.

The stock of Insulators we now have on hand **MUST** be sold.
We shall make a price which will **MOVE** them. You can afford to hold them for future use
WRITE FOR QUOTATIONS.

BIBBER-WHITE COMPANY,
49 Federal Street,
BOSTON, MASS.

NOVELTY ELECTRIC Co.,
PHILADELPHIA, PA.

Agents for
- Okonite Insulated Wires.
- Medbury Overhead Railway Material.
- Changeable Electric Headlights.
- Globe Metal Works' Trolley Wheels.
- P & B Electrical Compounds.
- Perkins Incandescent Lamps.
- Schiff, Jordan & Co.'s Ship Cored Carbons.

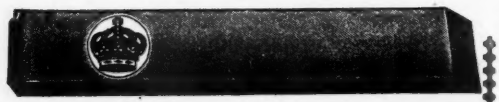
ELECTRICAL SUPPLIES OF EVERY KIND.

EFFICIENCY GUARANTEED. PRICES REDUCED. HIGHEST POSSIBLE CONDUCTIVITY.

Write us, stating size, and let us quote you and send you sample.
Our prices will save you *dollars.*

OHIO ELECTRIC SPECIALTY MFG. CO., TROY, OHIO.

OUR
CROWN BRUSH
Made flexible end-ways, side-ways or stiff. Send for samples and price list, and compare with other makes.



Crown Woven Wire Brush Co., Salem, Mass.

The Monarch Engine-Stop
—with Speed-Limit

attachment will positively prevent an engine from running away, and also enable it to be stopped from any point in the factory in case of accident, notifying the engineer at the same time. It is a first-class insurance at a low cost. It closes the Throttle-Valve. Why not investigate?

The Monarch Manufacturing Co.,

WATERBURY, CONN.

We want every user of Alternating-Current Apparatus to have a copy of this pamphlet. It contains much valuable information, instructions for testing Transformers and a very little advertising matter in regard to our Model '98 Transformers.

NEW YORK & OHIO COMPANY,

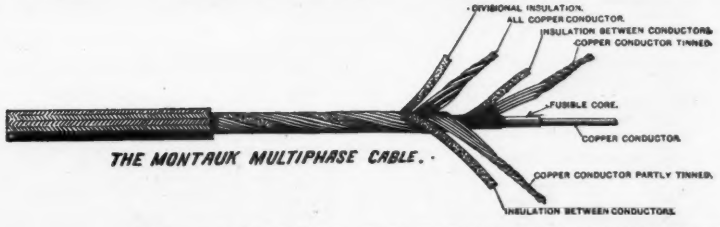
WARREN, OHIO.

CLING-SURFACE

Is a belt dressing, but so much more that we will send you a sample can and guarantee that the belts shall stop slipping; the power shall be PERMANENTLY increased; the belts can be run slack and the leather shall become as soft as calfskin; also absolutely waterproof. We will further agree that the increased power (in a fair-sized plant) shall earn the cost of the sample can EVERY MONTH. This applies to leather, rubber, cotton and rope, and also to OILY DYNAMO belts.

CLING-SURFACE MFG. CO., 178-184 Virginia St., Buffalo, N. Y.

THE MONTAUK MULTIPHASE CABLE A SUCCESS.



THE MONTAUK MULTIPHASE CABLE.

Being thermostatic in every infinitesimal part, it is alive to any dangerous heat or flame and gives automatic warning of same TO ANY DESIRED POINT. It is so constructed that it can be used in place of plain wire for all interior adaptions such as bells, telephone, district service, etc. It saves the expense of a watchman by acting as a burglar alarm, giving instantaneous warning when cut or disturbed in any way.

HAS PROVED THOROUGHLY SUCCESSFUL WHEREVER INSTALLED.

Adopted by Gamewell Auxiliary Fire Alarm Company. Montauk Cables are small, neat, flexible and perfectly insulated. Furnished in dampproof, waterproof or decorative construction, and in any desired color or length. Conductors are standardized to equal carrying capacity. Samples and descriptive matter on application. Use demonstrated at our office.

MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York. Telephone, 4031 Cortlandt.

Owing to his many engagements he may not have reached you. If so let us have your card so that his visiting list may be complete, and you be in receipt of—a Catalogue of to-day—our 1899 Publication.

The Friendly Beacon

The sputtering taper served its purpose in helping to keep back the crowding dark. Then Candles, Lamps, Gas and Incandescent Lights, all took turns, but the

Electric Candle,

in antique brass finish, is now presented.

Its simplicity and convenience make it almost indispensable. Just turn the little knob at the top and "It Works."

NO DIRT, ODOR, HEAT, WIRES OR MACHINERY.

Hang it up by your bed, put it on the floor, chair or table at night, and a good light is ready to be turned on any minute.

In going from room to room in the night, or enabling you to find at once just what you are looking for in a dark closet, it will give the greatest satisfaction.

ASK YOUR DEALER OR WRITE TO

UNITED STATES BATTERY CO.,

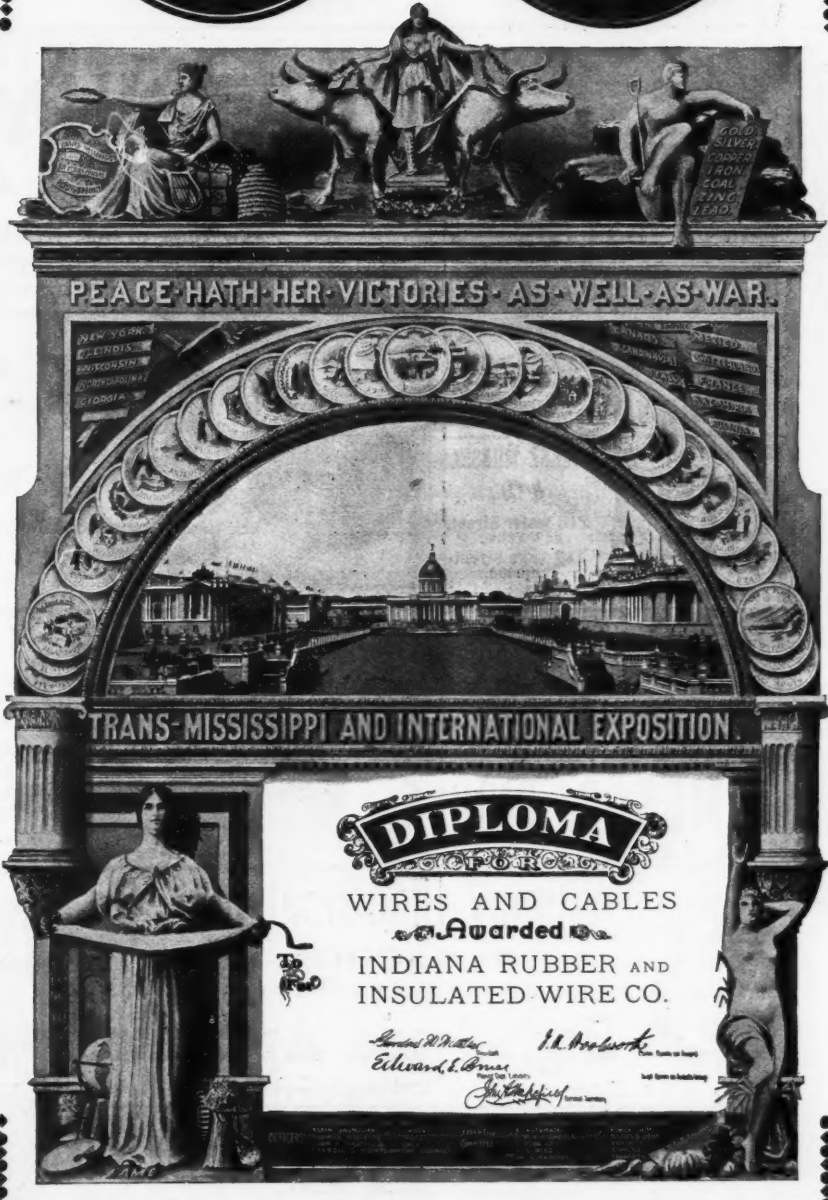
253 BROADWAY, NEW YORK.

INDEX OF ADVERTISERS.

	PAGE
A	
American Bell Telephone Co.	xviii
American Electric Telephone Co., long-distance telephones	xviii
American Electrical Directory	
American Electrical Works, insulated wire	i
American Engine Co.	xv
American Pegamoid Co.	i
American Tool Works Co.	xiii
American Vitrified Conduit Co.	i
Armington & Sims Co., engines	15
B	
Babcock & Wilcox Co	xx
Baker & Co., platinum	x
Ball & Wood Co., engines	xv
Barnes Co., The Wallace	x
Barron & Co., James S.	16
Beacon Lamp Co.	
Becker Name Plate Co.	i
Berlin Iron Bridge Co.	16
Bibber-White Co	vi
Biddle, James G.	x
"Big Four Route"	
Bogart Co., A. L.	15
Boker & Co., Hermann	x
Brady, T. H.	x
Bristol Co.	i
Brown-Bierce Co	x
Bubier Electric Co.	
Buckeye Electric Co.	iv
Bunnell & Co., J. H., dry batteries	i
C	
Cary Spring Works	x
Central Electric Co., electrical supplies	iii, viii
Central Manufacturing Co.	xiii
Cling-Surface Mfg. Co	vii
Clyde Line	
Columbia Incandescent Lamp Co.	i, ii
Connecticut Telephone and Electric Co.	
Crefeld Electrical Works	i
Crocker-Wheeler Electric Co.	i
Crofton Storage Battery Co.	
Crown Woven Wire Brush Co.	vi
Cutter Electrical and Mfg. Co., circuit-breakers	xi
D	
De Veau & Co.	xvii
Diehl Manufacturing Co.	
Dixon, Jos., Crucible Co., belt dressing	xi
Duval, E. S., Jr., patents	15
E	
Edison, Thos. A., Jr.	xix
Eastern Electric Cable Co.	v
Eastern Telephone Manufacturing Co.	xx
Eddy Electric Manufacturing Co.	i
Edison Decorative and Miniature Lamp Department	xiv
Electric Appliance Company, supplies	i
Electric Storage Battery Co.	
Electrical Engineer Institute of Correspondence Instruction	16
Empire China Works, porcelain specialties	iv
Eureka Electric Co.	xvii
F	
Fair Telephone and Construction Co.	xviii
Faraday Carbon Co., carbons	xiv
Forest City Electric Works	xiv
For Sale	15
Fort Wayne Electric Corporation	x
Frink, I. P.	xx
G	
G. & E. Electric Co.	iv
Garvin Machine Co.	
General Electric Co.	iv
Goldmark & Wallace	i
Gordon, A. Y.	xvii
H	
Harper & Bros.	
Hart & Hegeman, electric switches	iii
Helios Electric Co.	
Hobart Electric Manufacturing Co.	14
Holtzer-Cabot Electric Co.	
I	
Improved Electric Glow-Lamp Co., Ltd.	
India Rubber and Gutta Percha Insulating Co.	
Indiana Rubber and Insulated Wire Co.	ix
International Correspondence Schools	16
Ironclad Resistance Co.	16
J	
Jandus Electric Co.	
Joseph Iron Co., The Isaac	15
K	
K. & W. Company	
Keystone Electrical Instrument Co.	
Kirmayer & Oelling	16
Klein & Son, Mathias	15
L	
La Roche & Co., F. A.	16
Leffel & Co., James	v, 15
Lincoln Electric Co.	16
Lombard Water-Wheel Governor Co.	
M	
Manhattan Electrical Supply Co.	xvi
Manross, F. A.	x
Marshall, Wm., condensers	xviii
Massachusetts Chemical Co.	i
McIntire Co., The C.	
McKenney & Waterbury	
McLeod, Ward & Co.	iv
Mianus Electric Co.	xviii
Monarch Manufacturing Co.	vi
Montauk Multiphase Cable Co.	vii
Munsell & Co., Eugene	x
Murdock & Co., Wm. J.	xvii
N	
National Carbon Co	iv
National Conduit & Cable Co.	i
National India Rubber Co.	i
New England Engineering Co.	xv
New York & Ohio Co.	vii
New York Central R. R.	x
New York Patent Bureau	16
New York Insulated Wire Co., Grimshaw wires and cables	i
New York Telephone Co	xviii
Novelty Electric Co., supplies	vi
O	
Ohio Electric Specialty Manufacturing Co.	vi, 15
Ohio Electric Works	
Okonite Co., insulated wires and cables	i, xx
Ostrander, W. R., & Co., supplies	16
P	
Pacific Electric Co.	xii
Paiste, H. T., Co.	x
Partrick, Carter & Wilkins	15
Pass & Seymour	iv
Pennsylvania Electric Co., telephone supplies	xviii
Peru Electric Manufacturing Co.	
Phœnix Glass Co.	i,
R	
Reisinger, Hugo	xiv
Reliable Electric Manufacturing Co.	xvii
Ritchie & Sons	
Roberts Electric Supply Co., H. C.	
Rodrigues, M. R.	xx
Roche, Wm.	v
Roebling's Sons Co., John A.	xx
Royce & Marean, electrical supplies	15
S	
Safety Insulated Wire & Cable Co.	iv
Sawyer-Man Electric Co.	
Schiff, Jordan & Co.	
Schoonmaker, A. O.	x
Seneca Falls Mfg. Co.	iv
Shelby Electric Co.	
Simplex Electrical Co.	i
Sipe & Sigler	
Solar Carbon & Manufacturing Co.	xiv
Sprague Electric Co.	iv
Standard Thermometer & Electric Co.	iii
Standard Paint Co.	xiv
Standard Underground Cable Co.	i
Stanley Electric & Manufacturing Co.	
Stephenson Co., Ltd., John	xx
Sterling Supply & Manufacturing Co.	15
Stirling Co., water-tube boilers	xx
Stromberg-Carlson Telephone Mfg. Co.	xviii
T	
The Telephone Manufacturing Co.	xvi
Thornberry, Henry S.	15
U	
United States Battery Co.	viii
U. S. Desk & File Co	16
V	
Varley Duplex Magnet Co.	v
Viaduct Mfg. Co., telephones, etc.	xviii
Victor Telephone Manufacturing Co.	xvi
W	
Wanted	15
Ward Leonard Electric Co.	16
Warren Electric & Specialty Co.	
Warren-Medbery Co	
Washburn & Moen Manufacturing Co.	xx
Washington Carbon Co	iii
Wells, Heber	16
Western Electric Co.	v
Western Telephone Construction Co.	xvii
Westinghouse Electric & Mfg. Co.	xiv
Williams-Abbott Electric Co.	xvii
Williams Electric Co.	xvii
Wheeler Reflector Co.	v
White & Co., J. G., engineers and contractors	16
Whitman & Couch	
Whitney Electrical Instrument Co.	x
Woltereck, Herman C.	15
Woodward, F. L.	15
Y	
Young, W. C., Mfg. Co.	xiii

WHEN Writing for Catalogues, Information or Prices, **YOU WILL CONFER A FAVOR** on both the **ADVERTISER** and the **PUBLISHER** by mentioning the fact that you saw the advertisement in the **ELECTRICAL REVIEW.**

Highest Prize awarded for PARANITE Rubber-Covered Wires and Cables by Trans-Mississippi Exposition 1898



Insulated Wire and Cables for Aerial Submarine and Underground use

Telephone-Telegraph Cables a specialty

Indiana Rubber and Insulated Wire Co.

JONESBORO, IND.

DO YOU USE RESISTANCE WIRES?

BOKER'S SUPERIOR WIRE has three times the resistance of german silver; suitable for resistance in arc lamps, rheostats, etc.

BOKER'S $\frac{1}{10}$-$\frac{1}{20}$ WIRE gives increase of resistance for each centigrade .000005; $1\frac{2}{3}$ times the resistance of german silver.

We can furnish both grades in wire, sheets or ribbon.

STEEL MUSIC WIRE.

We are importers of the celebrated steel music wire made in Hagen, Germany, by **Messrs. EICKEN & CO.** This wire has gained a world-wide reputation for quality, uniform temper and accuracy of size. Wherever used it has been adopted in preference to other brands. We carry large stock of listed sizes.

SPECIAL MAGNET STEEL is now being made by **Messrs. JONAS & COLVER, Ltd.,** which answers requirements and demands never fully met before. The steel is of exceptional quality; carries an astonishing weight and retains the magnetism.

The largest companies, after elaborate tests, have adopted Messrs. Jonas & Colver's Special Magnet Steel, as it proved superior to any other steel for permanent magnets.

We also manufacture **PURE MALLEABLE NICKEL** in Wire and Sheets. *WESTFAELIAN NICKEL ROLLING MILL, SCHWERTE, GERMANY.*

HERMANN BOKER & CO.,

Send for catalogues, etc. **101 & 103 DUANE STREET, NEW YORK.**

Full of Life and Even Temper!
SMALL
SPRINGS
OF EVERY DESCRIPTION MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U. S. A.
ESTABLISHED 1857
FLAT OR ROUND WIRE STEEL OR BRASS. A complete assortment of high-grade COLD ROLLED STEEL kept in stock, 008 to .049 inch thickness.
Springs enameled or plated. Tempering done at short notice. Ribbon steel made to order.
Send samples and write for quotations.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc.

Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

PLATINUM

in sheet or wire, any size, shape or degree of hardness,

FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. R. R. Ave., **NEWARK, N. J.**

NEW YORK OFFICE, 121 LIBERTY STREET.

Scrap and Native Platinum Purchased.

INDIA AND AMBER

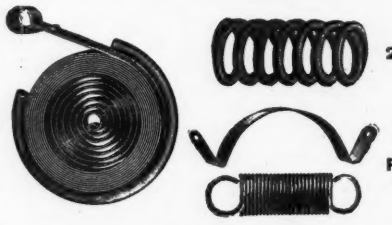
MICA

EUGENE MUNSELL & CO.,

218 Water Street, NEW YORK.

117 Lake Street, CHICAGO.

In any shape or pattern Write for Samples & Prices



CARY SPRING WORKS,

240 & 242 WEST 29th STREET, NEW YORK CITY.

Manufacturers of

WIRE and SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all kinds of Electrical Purposes.

MICA

All Sizes and Patterns

Write for samples and quotations

A. O. Schoonmaker

158 WILLIAM ST., NEW YORK

The "Jagabi" Portable Testing Set

is a compact, complete and convenient apparatus for resistance tests. Approved and used by the United States Government. Fully described in **Catalogue B, "Electrical Measuring Instruments."** Send 10c. in stamps for a copy.

JAMES G. BIDDLE,

907 Drexel Building, PHILADELPHIA, PA.

"Jagabi" Portable Testing Set.

THE BRADY MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.

Manufacturer of Mast-Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

GRACEFUL CURVES AND EASY GRADES

give comfort to a journey via the New York Central Lines between Chicago, St. Louis and Cincinnati, and New York and Boston. No other line approaches the New York Central in the number, character and speed of its trains.

For a copy of "The Luxury of Modern Railway Travel," send one 2-cent stamp to George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Whitney Electrical Inst. Co.,

PENACOOK, N. H.

MANUFACTURERS

High-Grade Apparatus.

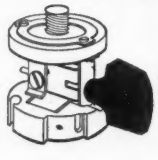
Send For Catalogue.

FORT WAYNE ELECTRIC CORPORATION

FORT WAYNE, IND.

APPARATUS FOR

ARC, DIRECT-CURRENT AND ALTERNATING INCANDESCENT LIGHTING AND POWER TRANSMISSION.



MAKING SOCKETS OUR SPECIALTY

Write for full particulars, free Samples, etc. We make many brands of

SOCKETS

Have saved others money. Can save you.

H. T. PAISTE CO.

CHICAGO **PHILADELPHIA**

DESIGNERS AND ENGRAVERS

BY ALL METHODS

Electrical Machinery and Apparatus

A SPECIALTY

GET OUR PRICES AND SPECIMENS BEFORE BUYING.

THE BROWN-BIERCE COMPANY.

DAYTON, OHIO.

NAME

Electrical Review

WHEN WRITING TO ADVERTISERS.

THE

G. & E. BORING MACHINE

For Electrical Wiring.

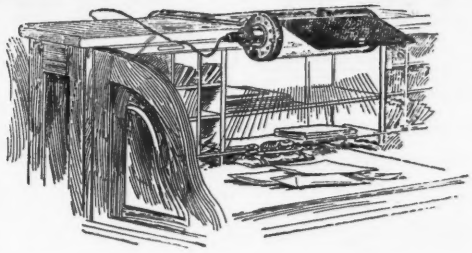
A GREAT LABOR SAVER.

Saves at least 50 per cent labor in boring holes; wires can be pulled through many holes; it saves wire; it saves the insulation. You need no stepladder for boring holes. If you want to control the wiring in your town, write for prices, etc., to the

G. & E. ELECTRIC CO.,

BINGHAMTON, N. Y.

THE REAL KINSMAN



Desk Lamp is better than any of its imitations, and is more economical. It's the only fixture made which will properly light the desk, and at the same time shield the eyes. Send for pocket catalogue and price-list.

McLEOD, WARD & CO.,

27 THAMES STREET, NEW YORK.

SAFETY

RUBBER COVERED

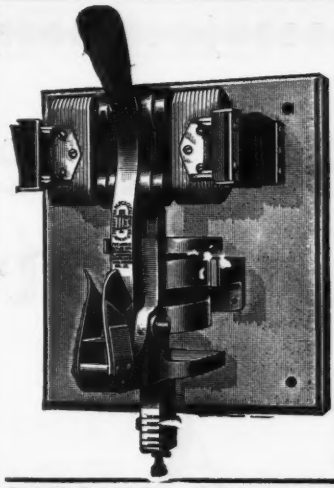
WIRES AND CABLES FOR EVERY SERVICE.

For Underground, Aerial and Submarine use, "Safety" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.

THE SAFETY INSULATED WIRE & CABLE CO.,

225 to 239 West 28th Street, New York.

LEONARD F. REQUA, General Manager.



We manufacture not only Single and Double Pole Circuit Breakers of capacity up to 8,000 amperes, but also Double Pole, Double Coil and Triple Pole instrum nts suitable for overload only, for underload only, and for over and und rload combined, either direct or alternating current.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

DIXON'S GRAPHITED WOOD GREASE

FOR TROLLEY CAR GEARS.

ABSOLUTELY PREVENTS NOISE AND DOES NOT OOZE OUT OF GEAR CASE.

"LASTS THREE TIMES AS LONG AS ANY OTHER LUBRICANT."

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

BRASS SOCKET CAUSES DEATH.

Engineer Electrocuted.

SEATTLE, WASH., October 14th.—Louis Kayazer, an engineer at the Seattle Steam Laundry, was electrocuted today. Kayazer was changing a small globe from one socket to another, and his hand came in contact with the socket. Death resulted in a few minutes.

SALT LAKE CITY, UTAH, Oct. 30, 1898.

Pass & Seymour, Syracuse, N. Y.,

GENTLEMEN:—I enclose you a copy of a press dispatch which was published in the local papers here a few days ago. It is a strong recommendation in favor of your porcelain socket, for had they been in use in this instance one man would not have been called to an untimely end. The enclosed copy is exactly as published.

Very truly yours,

[Signed] E. I. HOLDING.

COLUMBIA CARBONS

FOR ENCLOSED ARCS.

As Columbia is the gem of the ocean, so is the COLUMBIA the gem of Enclosed Arc Carbons.

MANUFACTURED BY

THE NATIONAL CARBON CO.

1140 West Madison Ave., CLEVELAND, O.

"Transformer Design and Operation."

Type H Transformer with Suspension Hooks.

AN ALTERNATING-CURRENT CENTRAL Station Company can not pay dividends unless it uses transformers having HIGH INSULATION, LOW IRON CORE LOSS, GOOD REGULATION AND LOW TEMPERATURE RISE. The General Electric Company is foremost in the movement to encourage the central station manager to make electrical tests on transformers, and to induce him to purchase only those which can be depended upon to give results in accordance with *manufacturers' claims.*

A new standard of excellence was made when the General Electric TYPE H TRANSFORMERS were introduced, and to-day there is no line of transformers equal to the Type H in the following essentials.

HIGH INSULATION, which means safety to customers, few burnouts and interruptions in service, low maintenance cost and small depreciation. Type H Transformers are insulated to withstand a 10,000-volt test between the primary and secondary.

LOW-CORE LOSS, resulting in small coal expense for magnetizing iron cores for transformers.

GOOD REGULATION, permitting the use of high-efficiency lamps and giving uniform light, satisfied customers and low cost for lamp renewals.

LOW-TEMPERATURE RISE, preventing ageing or increase of core loss, burnouts due to overheating of transformer, deterioration of insulation and shortening of life.

Many central stations that are now unable to pay dividends can be made profitable by substituting Type H transformers for those now in use. The coal expense can in many cases be reduced one-half.

Sales Offices:

Boston, Mass.	Nashville, Tenn.
New York, N. Y.	Chicago, Ill.
Syracuse, N. Y.	Detroit, Mich.
Buffalo, N. Y.	St. Louis, Mo.
Philadelphia, Pa.	Dallas, Tex.
Baltimore, Md.	Helena, Mont.
Pittsburg, Pa.	Minneapolis, Minn.
Atlanta, Ga.	Denver, Colo.
New Orleans, La.	Salt Lake City, Utah
Cincinnati, Ohio.	San Francisco, Cal.
Columbus, Ohio.	Portland, Ore.

For all business outside the United States and Canada:
Foreign Dept.—SCHENECTADY, N.Y., and 44 Broad Street, New York.
For Canada, address
Canadian General Electric Co., Ltd., Toronto, Ontario.

Send for a copy of the Pamphlet of which the above is the Preface.

General Electric Co.

PRINCIPAL OFFICES:

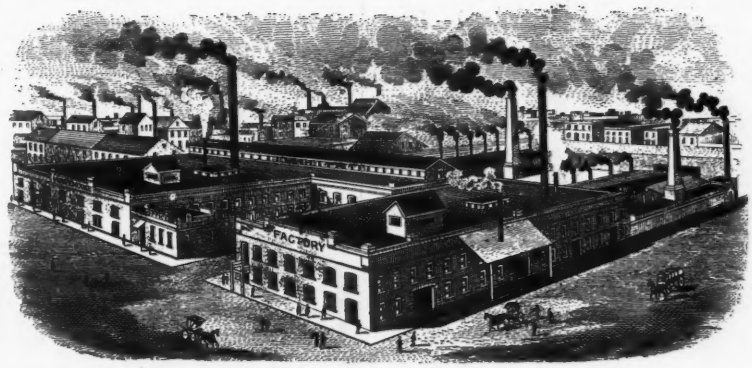
Schenectady, N. Y.

The name of the

DRY BATTERY

is

PROGRESS



There is no necessity for us to make and set up any claims for OUR DRY BATTERY.

We have produced it and ask you to allow us to send samples to you—charges paid.

Phoenix Carbon Mfg. Co.

ST. LOUIS, MO.

Electric Lighting

For any and every service is best served by Westinghouse Methods. Our long experience in electrical matters places us in position to determine what is best for each individual case. Our patrons have the benefit of this training without cost. Is it not better to buy from those who know whereof they speak?

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa.

OFFICES: New York, Atlanta, Austin, Boston, Buffalo, Chicago, Cincinnati, Philadelphia, St. Louis, San Francisco, Syracuse, Tacoma Denver, Mountain Electric Co. Canada, Ahearn & Soper, Ottawa. Mexico, C. & O. Braniff & Co., City of Mexico. Westinghouse Electric Co., Ltd., 32 Victoria St., London.

FOREST CITY ELECTRIC CLEVELAND O. **ROLL DROP** COMMUTATOR BARS HAVE STOOD THE TEST OF TIME

FARADAY CARBON COMPANY,

ELECTRIC LIGHT CARBONS

JEANNETTE, PA.

OUR STEREOPTICON LAMP

has a spiral filament in the form of an open watch spring. It gives 50 C.-P. at 50 to 120 volts. Candelabra, Decorative and Miniature Lamps and Receptacles described in Catalogue No. 9,044. X-Ray Tubes and Fluoroscopes in Catalogue No. 9,050.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,
(General Electric Co.)
Harrison, N. J.

THE STANDARD

P AND B

ELECTRICAL COMPOUNDS.
ARMATURE AND FIELD-COIL VARNISH.
INSULATING TAPE.
RUBEROID MOTOR CLOTH.

MANUFACTURED BY

The Standard Paint Company,

Chicago Office, 189 Fifth Avenue. 81-83 JOHN STREET, N. Y. Write for Particulars.

CARBON SPECIALTIES

Battery Cylinders, Telephone Transmitter Carbons, Carbon Brushes and Electric Light Carbons.

SOLAR CARBON & MANUFACTURING CO.

339 FIFTH AVENUE, PITTSBURGH, PA.

CARBONS

FOR ENCLOSED LONG-BURNING ARC LAMPS.

ELECTRA TRADE MARK

"ELECTRA"

FOR DIRECT CURRENT ARC-LAMPS

FOR ALTERNATING CURRENT ARC LAMPS

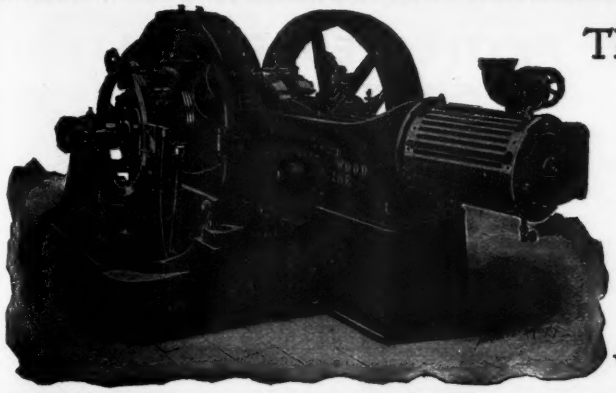
HIGHEST GRADE NUERNBERG CARBONS

UNEQUALLED IN QUALITY AND EFFICIENCY

ABSOLUTELY STEADY AND BRILLIANT LIGHT.

HUGO REISINGER 11 BROADWAY NEW YORK.

CARBONS



THE BALL & WOOD HIGH-SPEED ENGINE

is noted for its smooth and silent running, and its extremely low cost of maintenance. It is recognized as the standard engine for electric light and railway plants. Ball & Wood engines are made in all types for all services requiring the best economy and efficiency.

THE BALL & WOOD CO.,

Works, Elizabethport, N. J. 120 LIBERTY ST., NEW YORK CITY.

THE

NEW ENGLAND ENGINEERING CO.,

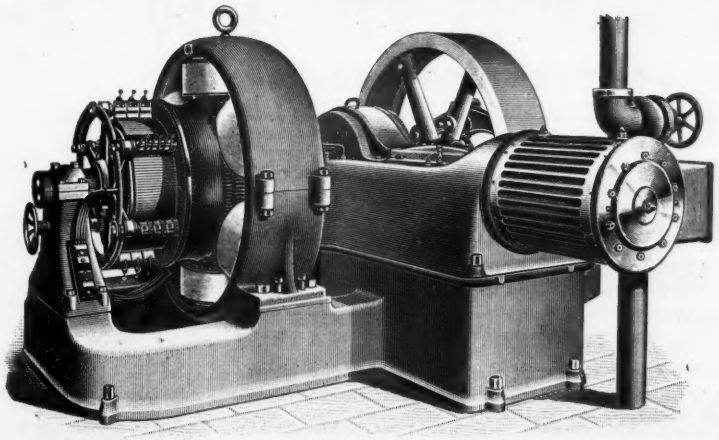
Waterbury, Ct.

CONSULTING ENGINEERS, MECHANICAL, ELECTRICAL.

A specialty made of steam plant construction and of gasworks.
We keep a large stock of supplies for central stations and private plants at lowest prices.
We sell the D. & W. Fuse. They never fail! Try them.

THE

New West India Trade



SANTO DOMINGO FALLING INTO LINE

The first direct-connected electric lighting plant on the island to be installed by the Porvenir Sugar Estate. The plant consists of an American-Ball Engine and direct-connected generator of 25 K. W. capacity, the complete plant being built by the

AMERICAN ENGINE COMPANY

48 Raritan Avenue, BOUND BROOK, N. J.

THE MOST RELIABLE GENERAL TELEPHONE APPARATUS MANUFACTURERS IN THE WORLD.

THE VICTOR APPARATUS IS FULLY PROTECTED BY PATENTS.

Our Style "C" 'Phone.

Our Style "C" 'Phone

is particularly adapted for exchange work. It is equipped with powerful generator, the Victor Double-Pole Receiver and solid-back transmitter, and is unquestionably the finest, most efficient and durable instrument on the market to-day. We guarantee our apparatus.

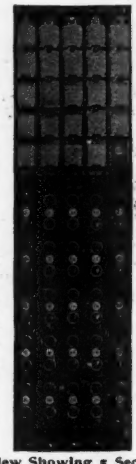
Our Style "K" 'Phone.

Our Style "K" 'Phone

is especially adapted for long-distance and toll-line work. It is provided with powerful generator and ringer, long-distance arm transmitter and double-pole receiver, an instrument of merit and fully equal to any service for which it may be desired. We guarantee our apparatus. We make 'phones of every description.

The Victor Express Switch-board

has no wires running into the back or jacks; all others have from three to six. This board is the most satisfactory ever offered to the telephone public. It is durable and simple, containing no useless trappings or superficial parts. It is durable and simple in construction, easy and rapid to operate and inexpensive to maintain. All parts are interchangeable and accessible without interfering with other parts or interruption of operation. This board is built in sections of five drops and jacks, mounted on hard rubber, invisibly wired and so constructed that when assembled it has the appearance and in fact is one solid front. Each subscriber has an individual ringing key, and the gravity drop used is a special feature owing to its positive action and easy restoration.



Front View Showing 5 Sections Drops and Jacks.

Back View Showing 5 Sections Drops and Jacks.

We make a full line of Telephone Apparatus. Write for any information.

VICTOR TELEPHONE MANUFACTURING CO., 166-174 So. Clinton St., CHICAGO.

NOW READY—CATALOGUE No. 10.

NET PRICE, $6.50.

A New Pocket Battery Gauge, to retail **$3.50,** will be ready Nov. 1st.

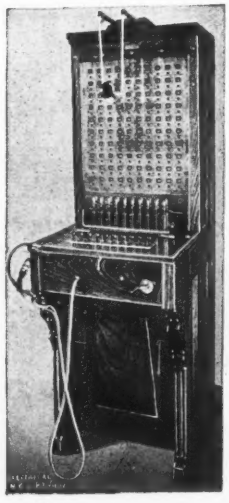
Something New in Burglar-Alarm Traps now ready. A lot of specialties we are now making can be purchased at the right price.

THE MESCO DRY BATTERY (better than ever).

Prices to suit buyers who are using cheaper grades.

MANHATTAN ELECTRICAL SUPPLY CO.

32 CORTLANDT STREET, NEW YORK.



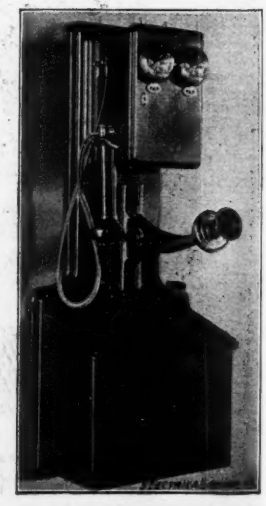
"IMPERIAL"

IMPERIAL TELEPHONES and SWITCHBOARDS are PERFECT in IMPERIAL ELECTRICAL and MECHANICAL EFFICIENCY. THE HIGHEST GRADE INSTRUMENT ON THE MARKET

If you are not using the "IMPERIAL" 'Phones you are making a great mistake. We guarantee BETTER CONSTRUCTION AND BETTER SERVICE at LESS COST of MAINTENANCE than can be secured with any other instrument. Our SWITCHBOARDS embody many new ideas and their service is always satisfactory. SIMPLEST and BEST CONSTRUCTED. DROPS and JACKS SELF-CONTAINED, and LINE and RING-OFF DROP-SHUTTERS SELF-RESTORED.

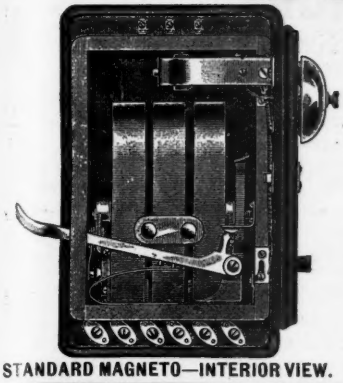
A trial is all we ask to convince you of the absolute superiority of our apparatus.

WRITE US FOR FURTHER DESCRIPTION AND PRICES.



THE TELEPHONE MFG. COMPANY, SUMTER, S. C.

A BELL THAT IS A BELL.



STANDARD MAGNETO—INTERIOR VIEW.

THE WILLIAMS-ABBOTT MAGNETO BELL.

Perfect, Electrically and Mechanically.

EVERY ONE GUARANTEED.

Why not get the best when you can get it at cost of poorest.
Our bell will outlive TWO of ordinary kind.

GET OUR PRICES.

Examine and test before closing any contracts.

THE BEST TELEPHONE BELLS AND RECEIVERS ON THE MARKET.

SEND FOR DESCRIPTION AND PRICES.

Correspondence Solicited.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY,

8, 10 and 12 Columbus St., CLEVELAND, OHIO.

OUR TESTING BELL.

WE MAKE THE BEST TELEPHONES, SWITCHBOARDS, RECEIVERS, TRANSMITTERS, AND PARTS, AT THE LOWEST PRICES.

Write us for the Telephone Pay-Station Signs that we are giving away, Free Gratis.

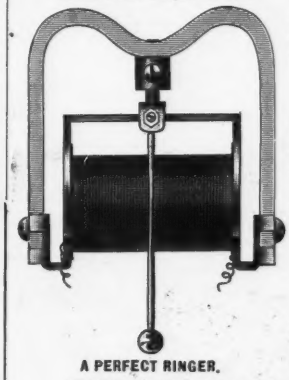
EUREKA ELECTRIC CO.

157-159 So. Canal Street,

Correspondence Solicited. CHICAGO.

Another Compliment to our Magneto Bells.

OUR SINGLE-CORE RINGER.



A PERFECT RINGER.

One of our Cleveland competitors has brought suit against the Eureka Electric Company, of Chicago, for **selling** our magneto bell. **We are** defending this suit at **our own** expense.

NOTICE.

We hereby guarantee to defend, at **our expense**, any and all patent suits that are brought against **our customers** or **anybody else** for the use of our apparatus.

Their magnetos are made under an old Williams's patent. **Our** magneto bell is manufactured under **new** Williams's patents. Which do you prefer, the **out of date** or the **up to date**?

MORAL.

Do not be **bluffed** into using **old** and out-of-date apparatus. Buy the **best** which the market affords; which on **magneto bells** and receivers is of **our make**. **We** will defend you.

THE WILLIAMS ELECTRIC CO.,

Manufacturers of MODERN magneto bells and receivers,

82-86 Seneca St., CLEVELAND, O.

Western Telephone Construction Co.

250-254 S. CLINTON STREET, CHICAGO, ILL.

Largest Manufacturers of

TELEPHONES AND SWITCHBOARDS EXCLUSIVELY

IN THE UNITED STATES.

Dixon's Pure Flake Graphite

Is a Blessing to Every Engine Room and Machine Shop.

A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.

Pamphlet and Sample Sent Free.

JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

THE NEW GORDON

LONG DISTANCE

Adjustable Transmitter Arm

Can be raised, lowered or swung laterally, instantly, to suit the user. Transmitter is held in a horizontal position always.

A. Y. GORDON, Patentee and Manufacturer,

MASSILLON, OHIO.

Lowest Price on Market!!

TELEPHONES

Over 50 STYLES to select from.

Our 100 Page Catalogues, etc., for the asking.

Reliable information that will start you right and keep you right.

ALL THE LATEST IMPROVEMENTS.

DE VEAU & CO.

26 ROSE STREET, NEW YORK.

ADVANTAGE IS MUTUAL when you mention that you saw an advertisement in the ELECTRICAL REVIEW.

THE M RECEIVER.

A STRICTLY HIGH-GRADE RECEIVER

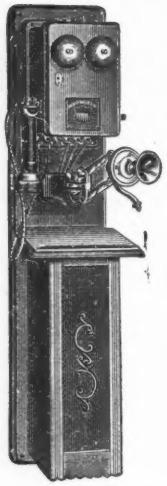
PONY TYPE.
DOUBLE-POLE.
HARD-RUBBER CASE.
PLATE BINDING-POSTS.
BEST STEEL MAGNETS.
WEIGHT, 12 OZ.

Magnet is supported near the diaphragm so that the change in temperature does not affect adjustment. Special price in quantities.

WM. J. MURDOCK & CO., 160 Congress St., Boston, Mass.

HIGH-GRADE NON-INFRINGING APPARATUS.

LARGEST MANUFACTURERS OF TELEPHONES AND ACCESSORIES IN THE U. S.



Our new Express System is adapted for use in both large and small exchanges; our Express switchboard is a new departure and possesses original features, being the most rapid switching apparatus ever devised.

SELF-RESTORING DROP.
SELF-RESTORING RING-OFF.
RAPID RINGING DEVICE.

Drops mounted in non-inductive metal shell, combined drop and jack in self-contained hard-rubber case, can be removed and replaced in board in one minute without disturbing connections. Each drop indicates as to whether line is working properly.

WILL PAY A DAILY DIVIDEND IN QUALITY OF SERVICE RENDERED.

OUR AMERICAN SOLID BACK AMPLIFYING TRANSMITTER

is the most powerful instrument yet produced. Especially built for Long and Severe Lines, and for volume of voice transmission, distinctness of articulation, exact reproduction of voice and durable qualities is unequaled.

Manufacturers of full line of devices of high efficiency adapted to meet special requirements of service, including the best Bridging Instruments and Repeating Coils on the market.

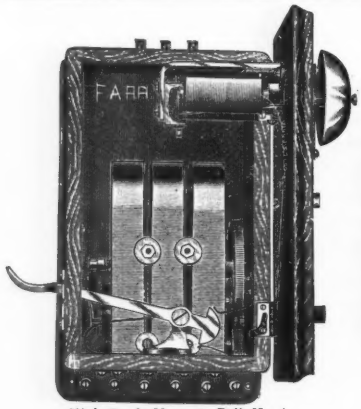
OVER 500 FLOURISHING EXCHANGES EQUIPPED.
PROTECTION GUARANTEED TO PATRONS.
EXPERT ADVICE FURNISHED.

Correspondence solicited. Address

AMERICAN ELECTRIC TELEPHONE CO.

Nos. 171-173 So. Canal Street, Chicago.

SEE OUR EXHIBIT, INTERNATIONAL EXPOSITION, OMAHA, 1898.
SEE OUR EXHIBIT, PARIS EXPOSITION, 1900.
MEDAL AWARDED, COTTON STATES EXPOSITION, ATLANTA, GA., 1895.
MEDAL AWARDED, TENNESSEE CENTENNIAL, NASHVILLE, TENN., 1897.



High-Grade Magneto Bell, No. 1.

WHOLESALE.

High-Grade Magneto Bell, No. 3.

MAGNETO BELLS AND TELEPHONES FOR EXCHANGES, TOLL LINES AND PRIVATE LINES.

SEND FOR CATALOGUE.

FARR TELEPHONE AND CONSTRUCTION SUPPLY CO.,
357 DEARBORN ST., CHICAGO.

Telephone Service at Your Office

is a recognized part of business equipment.

Telephone Service at Your House

is a convenience that once experienced will never be relinquished.

Message Rates make the cost of the service very moderate.

NEW YORK TELEPHONE COMPANY
15 Dey St., 962 Broadway, 125 West 125th St.

THIS ☎ HAS BEEN MAKING
TELEPHONES
20 YEARS, NOT CHEAP BUT SERVICEABLE AND FULLY GUARANTEED.
CIRCULARS FURNISHED.
VIADUCT ELECTRIC Co
BALTIMORE, MD., U. S. A.

ELECTRIC CONDENSERS.

WM. MARSHALL, Manufacturer.

STANDARDS A SPECIALTY

709 Lexington Avenue, New York.

TELEPHONE, as shown in cut, will talk 100 miles. Price, - $5.00

TWO-CELL, SWINGING-ARM TELEPHONE, . $7.75
HARD RUBBER RECEIVERS, ...65
ELECTROSE RECEIVERS, ...47

Above goods first-class in every respect. Send for catalogue.
Get prices on Batteries.

MIANUS ELECTRIC CO., MIANUS, CONN.

DIVIDED CIRCUIT TOLL LINE SYSTEM

far better than the bridging or series.

Absolutely free from the patent claims of others, including the broad claims of the Carbe patent for bridging telephone system recently upheld as valid in Pennsylvania.

DON'T BUY A LAWSUIT, BUY S-C APPARATUS.

All goods fully patented. Non-infringing.

GUARANTEED INDEFINITE.

The only manufacturers selling a full line of Public Exchange, Toll Line, Police, Fire-Alarm, Street Railway and Private Plant Telephone Equipment, fully protected by patent. We respect all patent claims of others.

— THE —

STROMBERG-CARLSON TELEPHONE MFG. CO.

72-82 W. JACKSON BOULEVARD, CHICAGO, ILL.

THE PENNSYLVANIA ELECTRIC CO., MARIETTA, PA.

Shook the Plum Tree at Omaha Exposition

AND THE HIGHEST AWARD FELL TO THEM FOR

Superior Telephone Apparatus.

CATALOGUES COME QUICKLY when you mention the ELECTRICAL REVIEW to the advertiser.

THE AMERICAN BELL TELEPHONE COMPANY,

125 MILK STREET, BOSTON, MASS.

This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.

BRILLIANCY ENDURANCE EFFICIENCY

"Edison, Jr." Improved Incandescent Lamp

Embodies these Features to the Highest Degree

Vacuum Highest Improved. Concentrated, Brilliant White Light. Carbons Never Become Red. Standard Candle-Power. No Electrician who consults the interests of his patrons will use the old-fashioned kind since the advent of the "EDISON, JR."

ALTHOUGH GREATLY SUPERIOR, THE PRICES OF THESE LAMPS HAVE NOT BEEN INCREASED.

Thomas A. Edison, Jr.

GENERAL OFFICES AND SALESROOMS:

27 William Street, New York.

Boston Office,	60 State Street.
Illinois Electric Company,	239 Madison Street, Chicago.
Austin Electrical Supply,	Austin, Texas.
Thompson & Company,	St. Paul, Minn.
Owen Burns,	405 Adams Building, San Francisco, Cal.
J. Boyd Dexter,	Annapolis, Md.
Wm. Gibbs Bain,	748 Drexel Building, Philadelphia.
Old Dominion Electric Company,	Norfolk, Va.

OKONITE
TRADE MARK.

1889
PARIS EXPOSITION MEDAL
FOR RUBBER INSULATION.

1898
WORLD'S FAIR MEDAL
FOR RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

— SOLE MANUFACTURERS OF —

OKONITE WIRES, OKONITE TAPE, MANSON TAPE,
CANDEE WEATHERPROOF WIRES.

THE OKONITE CO., Ltd.,

WILLARD L. CANDEE, } Managers.
H. DURANT CHEEVER, }
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

253 Broadway, N. Y.

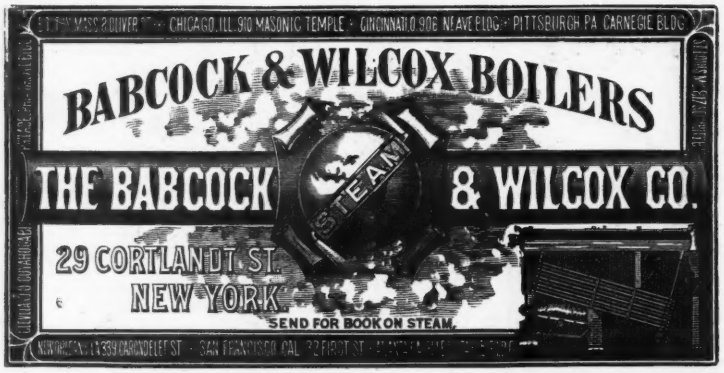
Bare and Insulated
ELECTRICAL WIRES
of Every Description.

Also Manufacturers of

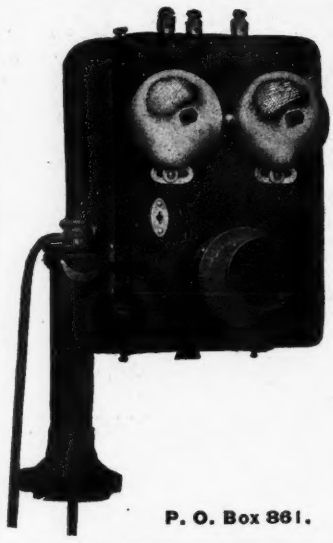
THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.
General Offices: WORCESTER MASS.

Warehouses and Offices:
NEW YORK. CHICAGO. SAN FRANCISCO. HOUSTON.
PHILADELPHIA. PITTSBURGH. BOSTON.



PREMIER PRODUCTS. Electric Motors of all sizes, from 10 oz. in weight up. Motors for special purposes at short notice. 1896 Discount sheet ready for the trade.
M. R. Rodrigues, 17 Whipple St., Brooklyn, N. Y.



$6.00 BUYS THIS TELEPHONE WITH BATTERIES.

Will talk perfectly one hundred miles.

Also a two-cell EXCHANGE 'PHONE with BATTERIES,

$8.50.

First-class in every respect.

Write for Circular explaining HOW WE CAN DO IT.

Eastern Telephone Mfg. Co.

P. O. Box 861. MERIDEN, CONN.

Frink's Sectional Glass Cluster Reflectors and Reflecting Shades In METAL FRAMES, lined with Silver-plated Corrugated Mirror or Opal Glass, are much stronger and far superior in light-giving qualities to the ordinary opal reflector, and the cost is but little more. They are very largely used for lighting stores, store windows, banks, offices, schools, hospitals, depots, office and public buildings generally.

TELEPHONE, 860 FRANKLIN.

No. 2306

No. 2505. Patented December 14th, 1897.

Book of Light, PRICE LISTS AND ESTIMATES FREE.
I. P. FRINK,
551 PEARL STREET, - NEW YORK.
Geo. Frink Spencer, Manager.

ROEBLING

THE STIRLING WATER TUBE SAFETY BOILER

SAFE,
EFFICIENT,
DURABLE.
OVER 500,000 H.-P. IN USE.

All wrought metal; no flat surfaces or stay bolts; four manholes give access to every tube. Quick and steady steam and thorough circulation guaranteed.

THE STIRLING COMPANY,
PULLMAN BUILDING, CHICAGO, ILL.

New York Office, - 126 Liberty Street.
Philadelphia Office, - Betz Building.
Baltimore Office, - Equitable Building.
Boston Office, - Room 17, 19 Pearl Street.

JOHN STEPHENSON COMPANY LIMITED
CAR BUILDERS, NEW YORK.
ORIGINAL TRAM-CAR BUILT IN 1831

OLDEST AND MOST WIDELY READ AND QUOTED ELECTRICAL WEEKLY IN THE UNITED STATES.

ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. XXXIV.—No. 14.
Copyright, 1899, by ELECTRICAL REVIEW PUB. CO.

NEW YORK, WEDNESDAY, APRIL 5, 1899.

TEN CENTS A COPY.
THREE DOLLARS A YEAR.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC
GLOBES, SHADES, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE? IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

ALL VOLTAGES

ANY CANDLE-POWER

COME
AND
SEE US
IN OUR NEW LOCATION.
FACILITIES
UNEQUALED.
ELECTRIC APPLIANCE COMPANY,
92 & 94 WEST VAN BUREN ST., CHICAGO,
America's Largest Electrical Supply House

NEW YORK & OHIO CO.,
WARREN, OHIO.
PACKARD . . . LAMPS AND TRANSFORMERS
NEW YORK OFFICE, 1 BROADWAY.

THE BRISTOL COMPANY
WATERBURY, CONN.

RECORDING VOLTMETERS,
RECORDING AMPEREMETERS,
RECORDING WATTMETERS,
RECORDING PRESSURE GAUGES,
RECORDING THERMOMETERS,
PAY FOR THEMSELVES.
SEND FOR CATALOGUE.

CROCKER-WHEELER CO.
Direct-Current Dynamos, Motors and Dynamotors.
Main Office: 39 Cortlandt Street, New York.
Works: Ampere, N. J.

WILLARD L. CANDEE, H. DURANT CHERVER, } Mgrs.
GEO. T. MANSON, Gen. Supt.
W. H. HODGINS, Secy.

1889
PARIS EXPOSITION
MEDAL FOR
RUBBER INSULATION.

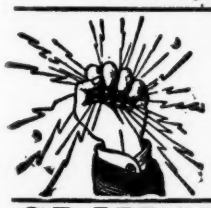
OKONITE
TRADE MARK

1893
WORLD'S FAIR
MEDAL FOR
RUBBER INSULATION

THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES. Write for Prices.
THE OKONITE CO., Ltd., 253 Broadway, New York.

NATIONAL CONDUIT & CABLE COMPANY,
Manufacturers and Patentees of
PAPER INSULATED CABLES and WROUGHT-IRON CEMENT-LINED PIPES for UNDERGROUND SUBWAYS.
73,000,000 Feet of Our Conduit and Thousands of Miles of Our Cables in Use in United States, Canada and the British Isles.
MAIN OFFICE:
TIMES BUILDING, NEW YORK.
Branches: { Rookery, Chicago, Ill. / Ames B'ld'g, Boston, Mass.

NAME PLATES FOR MACHINERY AND MOTORS
VOLTS AMP.
SOUVENIR BY MAIL.
The Becker Name-Plate Co.
34 Oliver Street, BOSTON, MASS.
Makers of switchboard, motor, arc-lamp, telephone and machinery NAME-PLATES. Dies for printing on wood, etc. Also steam type and embossing plates for all purposes. Send for estimate.



AMERICAN ELECTRICAL WORKS
PROVIDENCE, R. I.
Bare and Insulated Electric Wire.

STANDARD UNDERGROUND CABLE COMPANY,
Westinghouse Bldg., Pittsburgh, Pa.
13 Cortlandt Street, New York.
1235 Betz Building, Philadelphia, Pa.
542 The Rookery, Chicago, Ill.
507 Security Bldg., St. Louis, Mo.
FIBER PAPER RUBBER ELECTRIC CABLES,
CEMENT BRICK TILE WOOD CONDUITS.
HIGH-GRADE RUBBER COVERED AND WEATHERPROOF WIRES.
TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER.

GRIMSHAW WHITE CORE WIRES,
RAVEN WHITE CORE WIRES,
RAVEN BLACK CORE WIRES,
COMPETITION LINE WIRES,
GRIMSHAW and COMPETITION TAPES and SPLICING COMPOUNDS.
BRANCHES:
CHICAGO, 320 Dearborn Street.
BOSTON, 134 Congress Street.
SAN FRANCISCO, 71 Flood Building.
Manufactured by NEW YORK INSULATED WIRE COMPANY,
Main Office, 13-15-17 Cortlandt Street, New York.

KOCH Dynamo Brush
GOLDMARK & WALLACE,
Agents for U. S. 123 Worth St., New York.

WARREN ELECTRIC & SPECIALTY CO.,
WARREN, OHIO, U. S. A.
Manufacturers
"PEERLESS"
INCANDESCENT LAMPS, FAN MOTORS, TRANSFORMERS.

MONTAUK MULTIPHASE CABLE CO.
ONLY FIRE DETECTIVE CABLE IN THE WORLD.
See Description on inside page.
100 BROADWAY, NEW YORK CITY.

Our NEW IMPROVED BATTERY keeps the
American Electric Vehicle Co.
IN THE LEAD — PIONEERS ALWAYS
Send for Catalogue of Carriages
1545 Michigan Avenue Chicago, U. S. A.

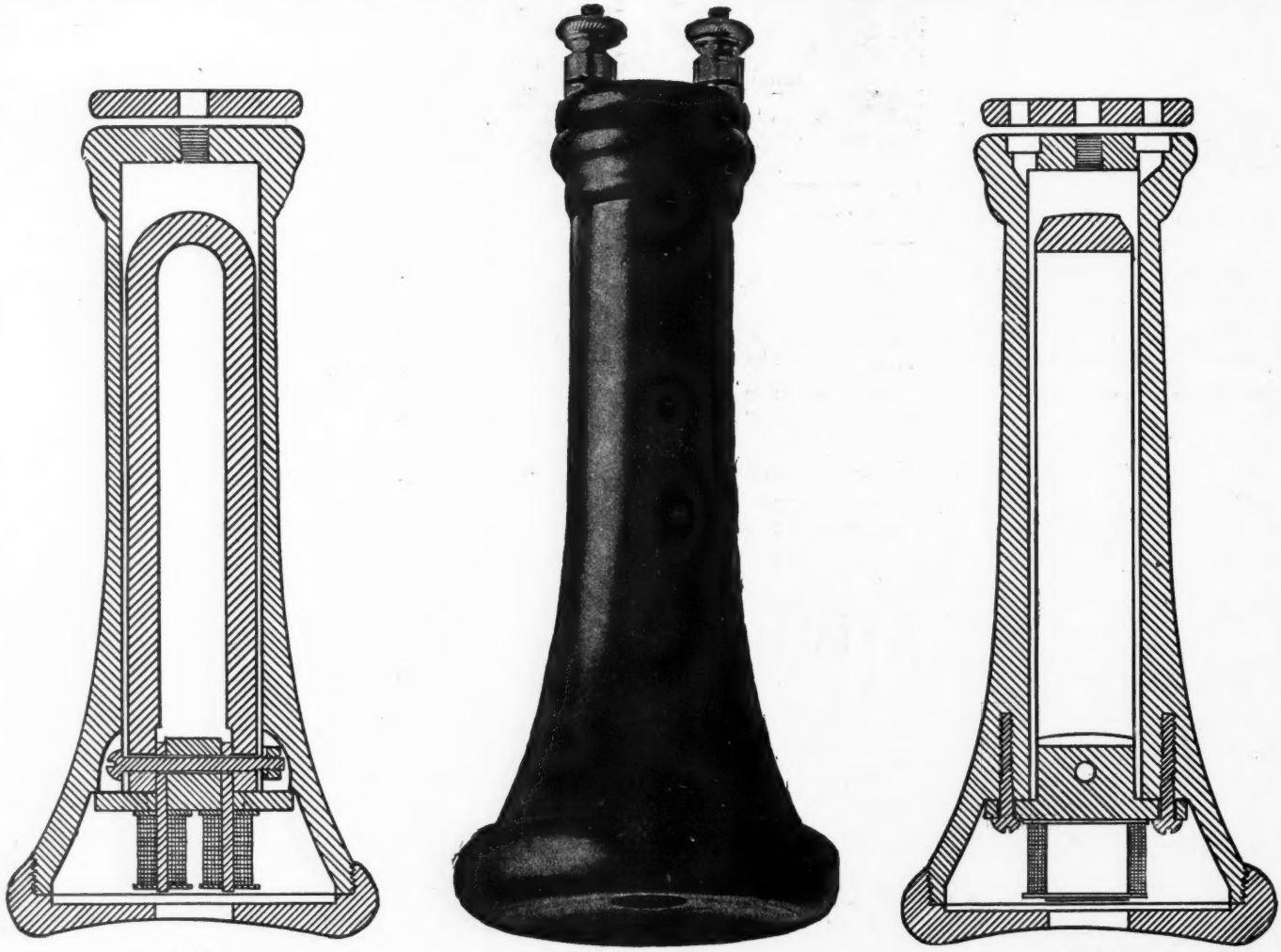
CREFELD ELECTRICAL WORKS
WIRES AND CABLES,
49 Federal Street, BOSTON.

American Vitrified Conduit Co.
VITRIFIED GLAZED CONDUITS.
UNDERGROUND CONDUIT SYSTEMS.
General Office, 39-41 Cortlandt St., NEW YORK.
C. J. Field, Gen. Man. and Chief Engineer.

SIMPLEX
WIRES AND CABLES
FOR UNDERGROUND SUBMARINE LINE
AND INSIDE CONSTRUCTION
The SIMPLEX ELECTRICAL CO
75 BICKNHILL BOSTON 1127 MONADNOCK BLOCK CHICAGO

W. & C.

BI-POLAR RECEIVER



Section 1. CUT FULL SIZE Section 2.

THOUSANDS NOW IN USE! GIVES PERFECT SATISFACTION TO OTHERS!! WHY NOT TO YOU?

If quality is a consideration send for a sample and get our prices.

GOOD STEEL AND ENOUGH OF IT.
POLE PIECES AND METAL HEADS RIGIDLY SUPPORTED.
ADJUSTMENT ACCURATE AND PERMANENT.

RUBBER SHELL OF BEST QUALITY.
WORKMANSHIP THOROUGH THROUGHOUT.
NO FREE SAMPLES.

No change of atmospheric conditions, like heat or cold, can in any way affect the adjustment of the receiver, inasmuch as the magnet is secured at a point near the head of the shell, and is entirely independent of the shell, except as the shell is a casing for the whole. The magnet has a close fit into the shell, allowing of no wabbling from side to side. The binding posts are of a pattern to insure their remaining fixed, and can not be turned or loosened by the tightening of the nut upon the receiver cord. Permanency of magnetism is assured by the excellent quality of steel used and the care employed in charging.

This is not all the good things we make in the telephone line.

WHITMAN & COUCH, Telephone Manufacturers,

214 SUMMER STREET, BOSTON, MASS., U. S. A.

STANDARD THERMOMETER & ELECTRIC CO.,

Main Office, PEABODY, MASS.

NEW YORK OFFICE, 141 Broadway, W. J. BRAMHALL, Resident Mgr.

CHICAGO OFFICE, 313 S. Canal Street, GEO. H. STOUT, Resident Mgr.

ARC LAMPS (OPEN AND ENCLOSED)

FOR ALL CIRCUITS.

THE UPTON "MIDGET" ENCLOSED ARC,

No. 370.

BEST IN THE MARKET.

STEADY WHITE LIGHT.

Single or Double Globe Arrangement.

No Parts to Wear or Get out of Order.

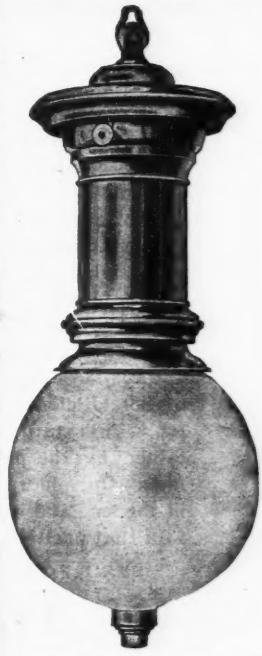
BURNS 125 to 150 HOURS.

Send for Bulletins "Series B."

AGENTS:

PHILADELPHIA: Etherington Co., 17th & Chestnut Sts.
PITTSBURG: Langton Electric Co., 243 Water St.
NEW ORLEANS: Newman-Spranley Co., 325 Baronne St.
SAN FRANCISCO: Dunham, Carrigan & Hayden Co., 17 Beale St.
MONTREAL, John Forman, 644 Craig St.
BELFAST (Ireland): Richard Patterson & Co., 57 High St.
LONDON (England): H. M. Salmony & Co., Ltd., 118 Charing Cross Road.

THE ZECO ENCLOSED ARC LAMPS



Electrically faultless from best mechanical construction and proper proportion of parts. Simplicity carried to highest limit. Current consumption easily adjusted, and giving pure white and steady light. Carbons interchangeable from upper to lower carbon-holders, giving complete carbon consumption. No carbon rods used, and all exposed parts of lamp nickel-plated.

Length of life from one trimming, 150 hours.

Operates singly upon 110 to 120 and 220 to 240-volt, direct-current circuits.

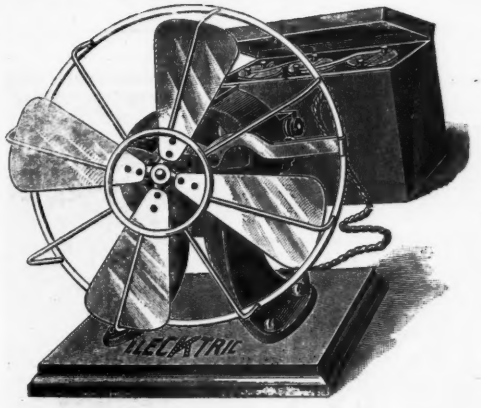
Made in several different styles.

CENTRAL ELECTRIC COMPANY,

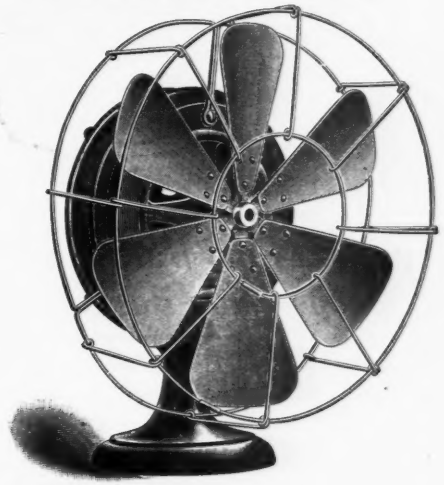
264-266-268-270 Fifth Ave., Chicago.

OKONITE IT NEVER DISAPPOINTS

FANS FOR DIRECT ALTERNATING AND BATTERY CURRENT.



Desk
Ceiling
and
Wall

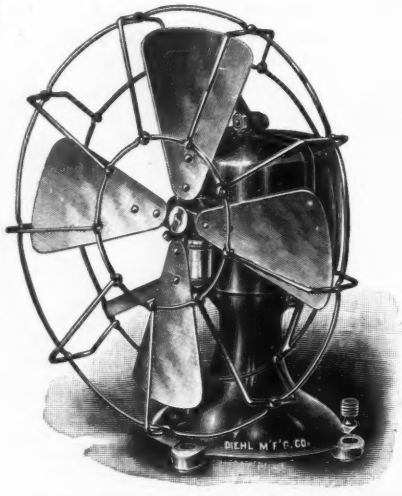


WRITE FOR CATALOGUE AND PRICE TO-DAY.

J. JONES & SON, 66 Cortlandt Street, New York.

DIEHL ELECTRIC FANS

For all Circuits, except Alternating.



Our line of electric fans for ALL purposes for the present season is the most complete that we have ever placed on the market, and the high standard of our product has been strictly upheld.

Our fans are the cheapest because they are absolutely the best made; wear longest, require less outlay for repairs and show a higher efficiency than any other fan. This statement is fully sustained by the past record of our fans. Our place has always been in the lead and we intend to maintain that position.

SEND FOR CATALOGUE.

DIEHL MANUFACTURING COMPANY,

SHOW-ROOMS: 561-563 Broadway, NEW YORK.
192-194 Van Buren St., CHICAGO.
128-132 Essex St., BOSTON.

Main Office and Works,
ELIZABETHPORT, N. J.

Hart "Standard" Switch.

COVER REMOVED.

You Don't Find Hart Switches in Scrap Heaps or on Bargain Counters.

CAUTION. To guard against fraud, all Hart Switches have the words "Hart Switch" stamped in the metal. When you order Hart Switches, make sure that this stamp is on switches received, as inferior switches are sometimes substituted when Hart Switches are ordered.

SOLD BY DEALERS EVERYWHERE.

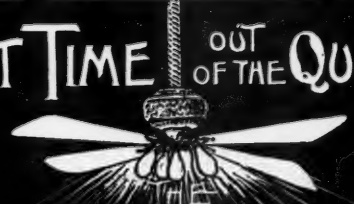
THE HART & HEGEMAN MFG. CO.
108 HIGH STREET, HARTFORD, CONN.

HAVE YOU RECEIVED OUR 1899 FAN MOTOR CATALOGUE?

If not, write for Catalogue No. 2008.

THE EMERSON ELECTRIC MFG. CO.,
714-716-718 St. Charles Street, ST. LOUIS, MO.

A HOT TIME OUT OF THE QUESTION



THE BATES ELECTRIC FANS DO IT.

Wound for any Voltage Direct or Alternating.

D.L.BATES & BRO. DAYTON, O.

For Ceiling or Desk A Written Guarantee with each FAN.

"STERLING" STANDARD SUPPLIES } FOR..... STREET..... RAILWAYS

ARE THE ASSEMBLING OF

EXPERIENCE, BEST MATERIAL, SUPERIOR WORKMANSHIP.

THE RESULT:

HIGHEST QUALITY GOODS.

FARE REGISTERS, FENDERS,

SAFETY BRAKES,

SAND BOXES.

INSULATION, COMMUTATORS.

Sterling Supply & Mfg. Co.,

141-155 East 25th Street, NEW YORK CITY.

SEND FOR FAN MOTOR CATALOGUE.

The W. E. Direct Current Standard Ceiling Fan Motor.

Made for 110, 220 and 550 Volts.

Artistic, Efficient, Noiseless.

Three Speeds, Four Blades or Two Blades.

With or Without Chandelier Attachment.

Bulletin 16 F Gives Full Description.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK.

Manufacturers and dealers Electric Light and Power Apparatus. Arc and Incandescent Lamps, Wire, Cable, Telegraph, Station and Measuring Instruments, Electric Light and General Supplies.

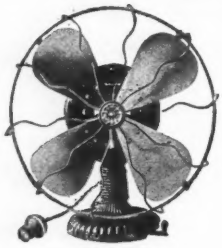
LONDON, 79 Coleman St., E. C., and North Woolwich, E.

ANTWERP, 33 Rue Boudewyns.

PARIS, 45 Avenue de Breteuil.

TO sell electric fans you must reach the trade. The best, most satisfactory and cheapest means of doing this is by advertising in the ELECTRICAL REVIEW, which goes each week to every electrical dealer worthy of your consideration. Your 1899 fan line is, or should be, ready. The season is approaching. It will be the best ever. Advertise now. Don't wait—it will lose you many sales.

ELECTRICAL REVIEW, TIMES BUILDING, NEW YORK CITY.



A. C. MOTOR.

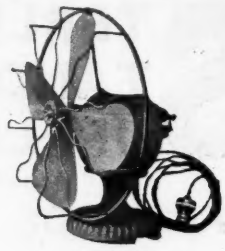
WESTINGHOUSE 1899 FAN MOTORS

For Alternating and Direct Current.

A. C. 50 and 100 Volts. 7,200 and 16,000 Alts. Two Speeds.

FURNISHED WITH CONNECTING WIRE AND PLUG.

D. C. 100 to 125 Volts. Three Speeds.



D. C. MOTOR.

WESTINGHOUSE ELECTRIC & Mfg. Co., Pittsburg, Pa.

WESTINGHOUSE ELECTRIC CO., LTD., 32 Victoria St., London, S. W., England.

And all principal cities in United States and Canada.

147-c

THE

NEW ENGLAND ENGINEERING CO.,

Waterbury, Ct.

CONSULTING ENGINEERS, MECHANICAL, ELECTRICAL.

A specialty made of steam plant construction and of gasworks.
We keep a large stock of supplies for central stations and private plants at lowest prices.
We sell the D. & W. Fuse. They never fail! Try them.

ASTORIA. ✳ DELMONICO'S. ✳ SHERRY'S.

HABIRSHAW

WIRES & CABLES

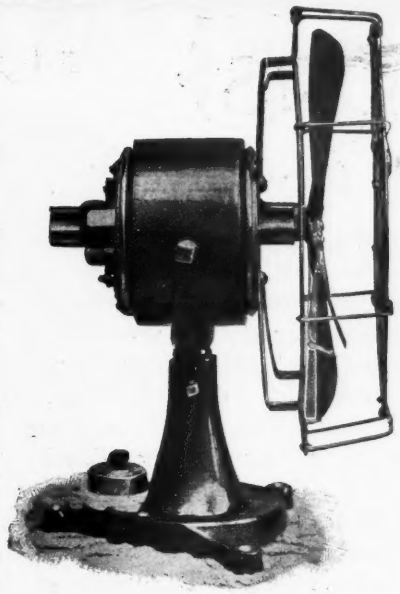
USED THROUGHOUT THIS BUILDING.

The India Rubber and Gutta Percha Insulating Co.

Main Office, Glenwood Works,

YONKERS, N. Y.

J. W. GODFREY, Manager Sales,
15 Cortlandt Street, New York.

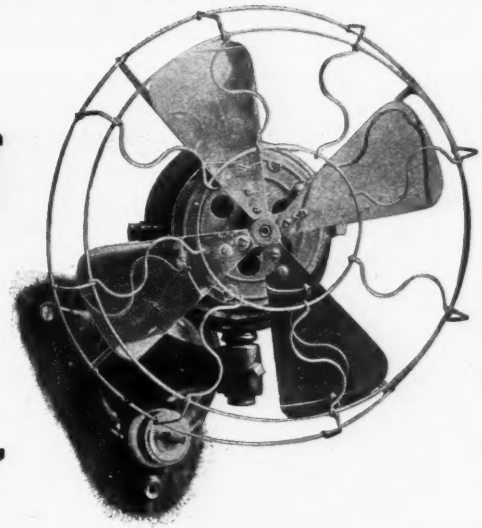


HERE ARE OUR

STANDARD SEARCH-LIGHT FANS.

12-inch and 16-inch Blades.

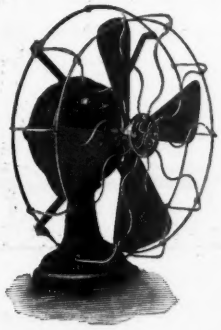
"The Grown-Up Fan."



Finished Superb Black Enamel with heavily nickeled trimmings. Did you see our previous ad. about the STANDARD CEILING FAN? Go look it up.

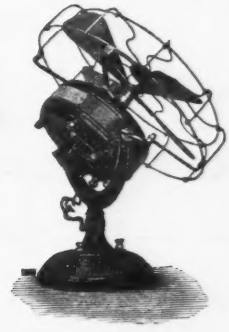
MANUFACTURED BY

The Robbins & Myers Co., SPRINGFIELD, OHIO, U. S. A.



THE

General Electric Co.'s FAN MOTORS



1899 MODELS

are made in styles suitable for portable use, for brackets, or for ceilings.

Fans are kept in stock to suit either direct or alternating current for any voltage or periodicity, and with either solid or trunnion bases.

Each fan motor is made to run at either a high or low rate of speed, and is equipped with highly polished, four-bladed brass fans and heavy brass guards.

The new single-speed noiseless, highly finished fan is specially adapted for sleeping rooms in hotels and private residences.

These fans are constructed to give the highest efficiency with the smallest consumption of current.

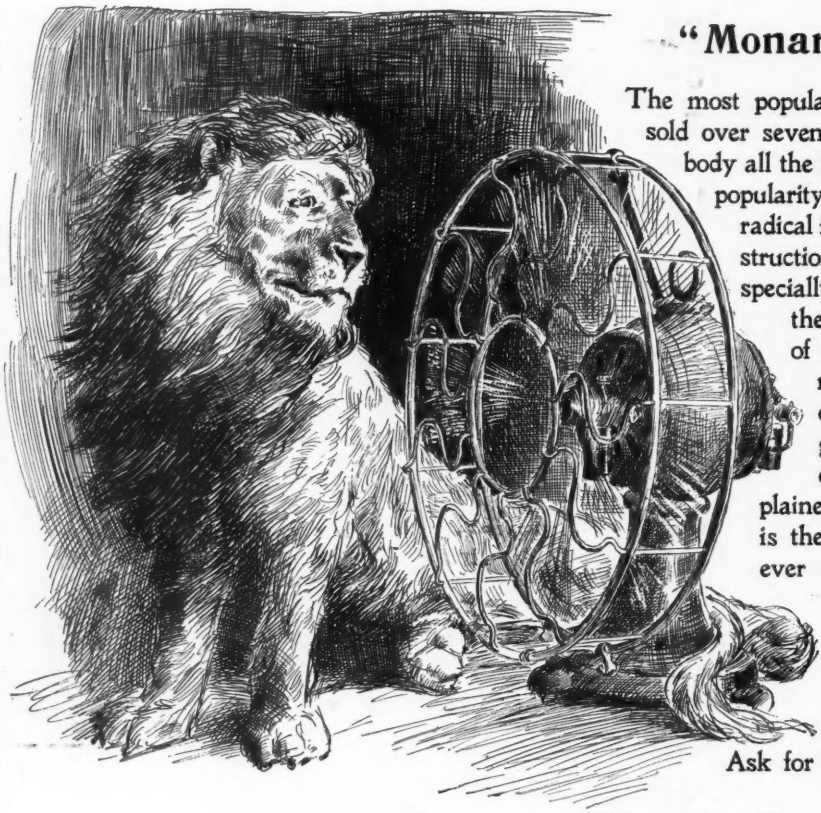
GENERAL ELECTRIC COMPANY.

Principal Offices: SCHENECTADY, N. Y.

Sales Offices in all large cities.

For all business outside the United States and Canada: Foreign Department, Schenectady, N. Y., and 44 Broad Street, N. Y.
For Canada, address Canadian General Electric Company, Limited, Toronto, Ontario.

LUNDELL FAN MOTORS



"Monarchs of all they survey."

The most popular Fan Motor since the day the first one was sold over seven years ago. The models for this season embody all the fine features that have made for the success and popularity of the Lundell in the past; but several very radical improvements have been made in details of construction. The field-frames are now drop-forged from a specially made grade of iron. This not only improves the appearance, but greatly increases the efficiency of the motor. The guard has also been very much improved in design and strength. Only one brace is needed to securely fasten the guard to the motor frame. The many excellent qualities of the Lundell are fully explained in our new Fan Motor Catalogue. This is the most complete and elaborate Fan Catalogue ever published, and a copy of it should be in the hands of every dealer, contractor and central station manager in the United States.

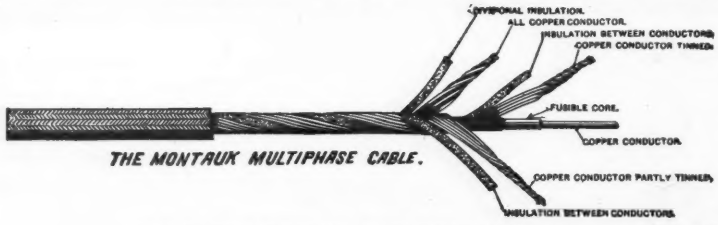
Please write your requests on the letter-head of your firm, or else enclose business card. Ask for Catalogue No. 666.

Sprague Electric Company,
20 Broad Street, New York.

CHICAGO,
Fisher Building.

THE MONTAUK MULTIPHASE CABLE

The only Fire Detective Cable in the World.



THE MONTAUK MULTIPHASE CABLE.

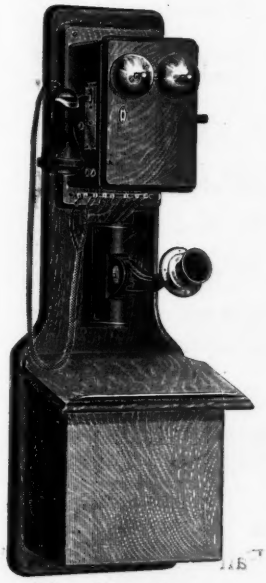
Being thermostatic in every infinitesimal part, it is alive to any dangerous heat or flame and gives automatic warning of same TO ANY DESIRED POINT. It is so constructed that it can be used in place of plain wire for all interior adaptions such as bells, telephone, district service, etc. It saves the expense of a watchman by acting as a burglar alarm, giving instantaneous warning when cut or disturbed in any way.

HAS PROVED THOROUGHLY SUCCESSFUL WHEREVER INSTALLED.

Adopted by Gamewell Auxiliary Fire Alarm Company. Montauk Cables are small, neat, flexible and perfectly insulated. Furnished in dampproof, waterproof or decorative construction, and in any desired color or length. Conductors are standardized to equal carrying capacity. Samples and descriptive matter on application. Use demonstrated at our office.

MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York. Telephone, 4031 Cortlandt.

THE "NORTH"



No. 6.

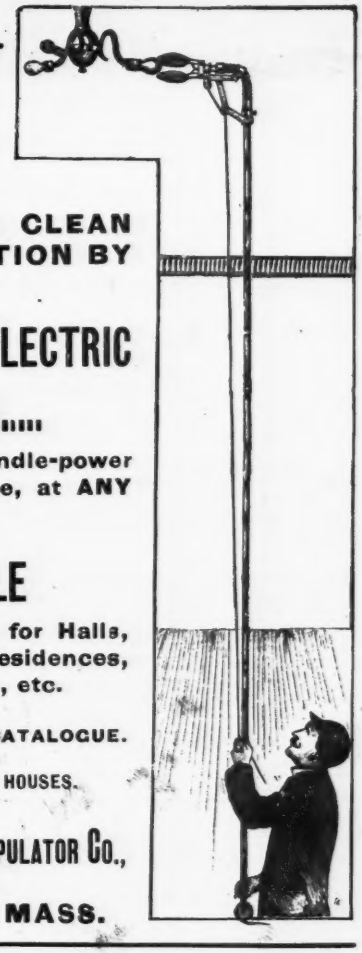
Write us and we will tell you all about the finest transmitter arm on the market.

Our factory produces every device for a telephone exchange.

The North Electric Co.

361-373 Frankfort Street, CLEVELAND, OHIO.

A NEW INVENTION!!!



KEEP YOUR LIGHTS CLEAN AND IN GOOD CONDITION BY USING

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR.....

It is made to fit **ANY** candle-power bulb, of **ANY** standard make, at **ANY HEIGHT** or **ANGLE.**

TELESCOPIC POLE

JUST WHAT IS NEEDED for Halls, Theaters, Street Lamps, Residences, Public Buildings, Stores, etc., etc.

SEND FOR DESCRIPTION AND CATALOGUE.

FOR SALE AT ALL LEADING SUPPLY HOUSES.

INCANDESCENT ELECTRIC LIGHT MANIPULATOR CO.,

ROOM 506,
116 BEDFORD ST., BOSTON, MASS.

"How to Become an Electrical Engineer."

A series of prize essays giving *valuable practical* advice to young men *deciding upon a career.* Contains also a list of colleges in the United States where electrical engineering is taught. Bound in paper, pocket size, *price 25 cents.* Send silver or stamps Address

Electrical Review, Times Bldg., N. Y.

GENERAL INCANDESCENT ARC LIGHT CO.,

GENERAL OFFICES AND FACTORY:
572-4-6-8 First Ave., Bet. 33d & 34th Sts.
NEW YORK.
Chicago Sales Office:
MARTIN J. INSULL CO., 1012-1013 Monadnock Block.

MANUFACTURERS OF THE

BERGMANN ENCLOSED ARC LAMPS, SWITCHES AND OTHER HIGH-GRADE ELECTRICAL SPECIALTIES...

MATCHLESS ELECTRIC LIGHTER!

MAKE MONEY QUICK.

AGENTS WANTED. Electric Light or Battery Current.
Endorsed by Fire Underwriters. A practical Electrical Novelty.
Sells at Sight. SPECIAL PRICES TO THE SUPPLY TRADE.
Send for Descriptive Circular.

STANLEY & PATTERSON, General Electrical Equipment Supplies. **32-34 Frankfort St., New York.**

PRACTICAL RUNNING OF DYNAMOS.

50 Pages, Illustrated. 10 Cents.

A little booklet explaining the locating and management of Dynamos. Directions for finding the Current in a Dynamo Armature and Electric Motor; Care in the Handling of Armatures; Replacing Field Magnets; Causes of Unusual Heating of the Bearings; Care and Attention to the Commutator and Brushes; Fourteen Causes of Sparking and Remedies; General Faults; Coupling Two or More Dynamos in one Circuit; Diseases of Dynamos; Causes of Flats in the Commutator; Faults of Alternators; Vibration and Noise, etc.

Catalogue of Mechanical and Electrical Books sent free.

PHILA. BOOK CO., C 15 South Ninth St., Phila., Pa.

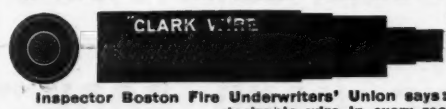
EVERY ONE KNOWS

or ought to know, that we lead in the manufacture of Candelabra, Series, Decorative, Battery and Miniature lamps. Our latest Catalogue (No. 1017) to be had for the asking.

Some of our special X-Ray tubes have Iridium targets. The regulars have Platinum targets. We are still making the best Barium fluoroscopes.

EDISON DECORATIVE & MINIATURE LAMP DEPT.
(General Electric Co.),
Harrison, N. J.

THE "CLARK" WIRE



FOR SWITCHBOARD, RAILWAY AND MOTOR USE.

All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public, and in use for the past 10 years, and has met with universal favor. We guarantee our insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treasurer and General Manager.
HERBERT H. EUSTIS, President and Electrician.

61-63 Hampshire St., BOSTON, MASS.

NOVELTY ELECTRIC Co.,

PHILADELPHIA, PA.

Agents for
- Okonite Insulated Wires.
- Medbury Overhead Railway Material.
- Changeable Electric Headlights.
- Globe Metal Works' Trolley Wheels.
- P & B Electrical Compounds.
- Perkins Incandescent Lamps.
- Schiff, Jordan & Co.'s Ship Cored Carbons.

ELECTRICAL SUPPLIES OF EVERY KIND

KNIFE SWITCHES * SWITCHBOARDS.

MANUFACTURING ELECTRICIANS.

Send for our Illustrated Catalogue.

STEPHEN D. LARGE & CO.,

Formerly Large & Twining,

328 Chestnut St., PHILADELPHIA, PA.

EFFICIENCY GUARANTEED. PRICES REDUCED. HIGHEST POSSIBLE CONDUCTIVITY.

Write us, stating size, and let us quote you and send you sample.

Our prices will save you *dollars.*

OHIO ELECTRIC SPECIALTY MFG. CO., TROY, OHIO.

TWO THOUSAND Dynamos and Motors .....in Constant Operation

The HOBART Multipolar and Bipolar Dynamos and Motors are noted for their

Simplicity, Durability, Efficiency

HIGHEST QUALITY AT MOST REASONABLE PRICES

General Electrical Appliances

WRITE FOR PRICES CORRESPONDENCE SOLICITED

Hobart Electric Mfg. Co., Troy, Ohio

"TELEPHONE HAND BOOK,"

By WEBB.

UP-TO-DATE—$1.00.

Address: ELECTRICAL REVIEW, N. Y.

VALUABLE ELECTRICAL BOOKS.

ELECTRIC LIGHT AND POWER.

Allsop's "Practical Electric Light Fitting;" a treatise on electric light wiring and fitting. Price..... $1 50

Noll's "How to Wire Buildings." Price..... 1 50

Crocker-Wheeler's "Practical Management of Dynamos and Motors;" description and directions. Price..... 1 00

Buckley's "Electric Lighting Plants;" cost and operation. Price, 2 00

Crocker's "Electric Lighting;" for the use of electricians, students and others interested in the installation or operation of electric lighting plants. Price..... 3 00

Latimer's "Incandescent Electric Lighting;" a practical description of the Edison system. Price..... 50

Unwin's "Development and Transmission of Power from Central Stations;" a new and timely book. Price..... 3 50

Bell's "Electric Power Transmission;" a practical treatise for practical men. Price..... 2 50

Atkinson's "Elements of Electric Lighting." Price..... 1 50

ELECTRIC RAILWAY.

Perry's "Electric Railway Motors;" their construction, operation and maintenance. Price..... 1 00

Merrill's "Reference Book of Tables and Formulas for Electric Street Railway Engineers." Price..... 1 00

Trevert's "Electric Railway Engineering;" embracing practical hints upon power-house, dynamo, motor and line construction; for the use of students Price..... 2 00

TELEPHONE.

Allsop's "Telephones: Their Construction and Fitting." Price..... 2 00

Hopkins's "Telephone Lines and Their Properties;" design and construction of city lines. Price..... 1 50

Poole's "Practical Telephone Hand-Book." New edition. Price .. 1 50

Webb's "Telephone Hand-Book." Price..... 1 00

Haskins's "Telephone Troubles and how to Find Them;" a complete hand-book for telephone inspectors. Price..... 25

Bennett's "Telephone Systems of Europe;" new and very complete Price..... 4 50

Preece & Stubb's "Manual of Telephony." Price..... 4 50

Houston & Kennelly's "Electric Telephony." Price..... 1 00

Cary's "How to Make and Use the Telephone." Price..... 1 00

X RAY.

Meadowcroft's "A B C of the X Rays." Price..... 75

Thompson's "Roentgen Rays and Phenomena of the Anode and Cathode." Price..... 1 50

Morton & Hammer's "The X Ray, or Photography of the Invisible." Price..... 50

Trevert's "Something about X Rays for Everybody." Price..... 25

Norrie's "Ruhmkorff Induction Coils." Price..... 50

MISCELLANEOUS.

Cushing's "Standard Wiring." Price..... 1 00

Thomson's "Dynamo Electric Machinery." Price..... 6 00

Meadowcroft's "A B C of Electricity." Price..... 50

Tesla's "Experiments with Alternate Currents of High Potential and High Frequency"—A Lecture with biographical sketch. Price. 1 00

Edison's "Life and Inventions;" by W. K. L. and A. Dickson. Price..... 4 50

Trevert's "How to Build Dynamo Machinery." Price..... 2 50

Parkhurst's "Electric Motor Construction for Amateurs." Price... 1 00

Benjamin's "Age of Electricity—From Amber-soul to Telephone." Price..... 2 00

Foster's "Central Station Bookkeeping." Price..... 2 50

Houston's "Dictionary of Electrical Words, Terms and Phrases." Price..... 5 00

Replogle's "Electricity and Water-Power." New. Price..... 1 00

Ayrton's "Practical Electricity;" for first year students of electrical engineering. New. Price..... 2 50

Grier's "Note-Book of Wiring Tables;" How they are made, and how to use them. Price..... 1 00

Hawkin's "New Catechism of Electricity." Price..... 2 00

All of these books sent prepaid on receipt of price. Address

ELECTRICAL REVIEW PUBLISHING CO.,

P. O. Box 2339. 41 PARK ROW, NEW YORK.

ESTABLISHED 1878.

J. H. BUNNELL & CO.,

76 CORTLANDT STREET, CORNER WASHINGTON STREET, NEW YORK.

WE ARE HERE TO FILL ORDERS FOR **EVERYTHING ELECTRICAL** AT **RIGHT PRICES. . . . . .**

Prompt Attention Given to All Inquiries and Orders. We shall continue to deserve the Honored Distinction of being the Makers of the **BEST TELEGRAPH INSTRUMENTS ON EARTH!!**

They are the Acknowledged Standard of the World. We have just issued a new TELEPHONE CATALOGUE AND MANUAL OF TELEGRAPHY. Send for a copy, and mention this paper.

J. H. BUNNELL & CO., 76 CORTLANDT STREET, COR. WASHINGTON STREET, **NEW YORK.**

BUCKEYE INCANDESCENT LAMPS

QUALITY UNEQUALED. FACTORY PRODUCTION TRIPLED.

THE BUCKEYE ELECTRIC CO.,

Monadnock Building, Chicago. - - - - Cleveland, Ohio.

THE

G. & E. BORING MACHINE

For Electrical Wiring.

A GREAT LABOR SAVER.

Saves at least 50 per cent labor in boring holes; wires can be pulled through many holes; it saves wire; it saves the insulation. You need no stepladder for boring holes. If you want to control the wiring in your town, write for prices, etc., to the

G. & E. ELECTRIC CO.,

BINGHAMTON, N. Y.

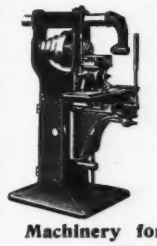
THE GARVIN MACHINE CO.

SPRING AND VARICK STREETS, N. Y.

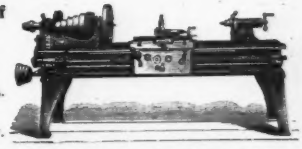
BUILDERS OF

MACHINE TOOLS

Special and Automatic Machinery built to drawings.



Machinery for the manufacture of Electrical Goods.

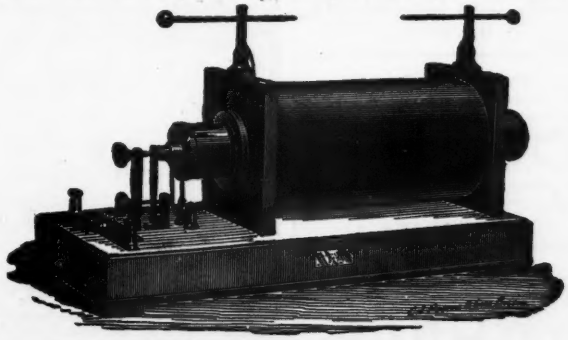


Philadelphia Store: The Garvin Machine Co., 51 North 7th Street, Philadelphia, Pa.

Berlin Store: The Garvin Machine Co., m. b. H., 17 Burg Strasse, Berlin, C, Germany.

The Ritchie Induction Coils

producing best results in X-Ray work are made by us expressly for this work.



All our coils give a spark from one to two inches above rating. It is known that the founder of this company invented the adopted method of induction coil winding in 1858.

Send for prices and information; catalogue of fine electrical and scientific instruments free.

E. S. RITCHIE & SONS,

Brookline, - - - - - Mass.

LATHES, PUNCHES AND SHEARS.

Send for Price-List and Catalogue.

W. C. YOUNG MFG. CO.,

Box 1123, WORCESTER, MASS.

Telegraph Address, Young Worcester, Western Union Code Used.

DO YOU USE RESISTANCE WIRES?

BOKER'S SUPERIOR WIRE has three times the resistance of german silver; suitable for resistance in arc lamps, rheostats, etc.

BOKER'S 1-10 WIRE gives increase of resistance for each centigrade .000005; 1⅗ times the resistance of german silver.

We can furnish both grades in wire, sheets or ribbon.

STEEL MUSIC WIRE.

We are importers of the celebrated steel music wire made in Hagen, Germany, by **Messrs. EICKEN & CO.** This wire has gained a world-wide reputation for quality, uniform temper and accuracy of size. Wherever used it has been adopted in preference to other brands. We carry large stock of listed sizes.

SPECIAL MAGNET STEEL is now being made by **Messrs. JONAS & COLVER, Ltd.,** which answers requirements and demands never fully met before. The steel is of exceptional quality; carries an astonishing weight and retains the magnetism.

The largest companies, after elaborate tests, have adopted Messrs. Jonas & Colver's Special Magnet Steel, as it proved superior to any other steel for permanent magnets.

We also manufacture **PURE MALLEABLE NICKEL** in Wire and Sheets. *WESTFAELIAN NICKEL ROLLING MILL, SCHWERTE, GERMANY.*

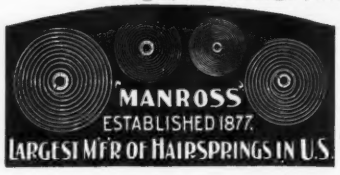
HERMANN BOKER & CO.,

Send for catalogues, etc. **101 & 103 DUANE STREET, NEW YORK.**

Full of Life and Even Temper!
SMALL
SPRINGS
OF EVERY DESCRIPTION MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U. S. A.
ESTABLISHED 1857
FLAT OR ROUND WIRE. STEEL OR BRASS A complete assortment of high-grade COLD ROLLED STEEL kept in stock, .003 to .049 inch thickness.
Springs enameled or plated. Tempering done at short notice. Ribbon steel made to order.
Send samples and write for quotations.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc.



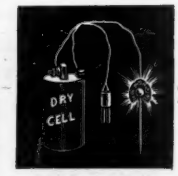
Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

New Standard Dry Battery.

U. S. NAVY STANDARD and STANDARD OF THE WORLD



It will please you in every way for open-circuit work. Made in any style from 1 3-16 to 3 in. diam., and 2 to 7 in. high. The only reliable cell (dry) now before the public.

Will send new Standard Electric Necktie Pin, anywhere, post-paid, for ONE DOLLAR.

WILLIAM ROCHE,

259 Greenwich Street, NEW YORK,

INVENTOR AND MANUFACTURER.

INDIA AND AMBER

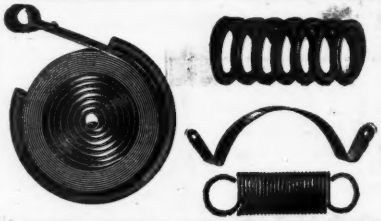
MICA

In any shape or pattern Write for Samples & Prices

EUGENE MUNSELL & CO.,

218 Water Street, NEW YORK.

117 Lake Street, CHICAGO.



CARY SPRING WORKS,

240 & 242 WEST 29th STREET, NEW YORK CITY.

Manufacturers of

WIRE and SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all kinds of Electrical Purposes.

DESKS,

Chairs, Cabinets, Letter Files

4 ft long $13.50 cash with order.

THE U. S. DESK, FILE & CABINET CO., INDIANAPOLIS, IND.

Dixon's Pure Flake Graphite

Is a Blessing to Every Engine Room and Machine Shop.

A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.

Pamphlet and Sample Sent Free.

JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

THE BRADY MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.

Manufacturer of Mast-Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

AMERICA'S MOST POPULAR RAILROAD

Chicago & Alton R.R.

PERFECT PASSENGER SERVICE BETWEEN

CHICAGO AND KANSAS CITY.
CHICAGO AND ST. LOUIS.
CHICAGO AND PEORIA.
ST. LOUIS AND KANSAS CITY.

If you are contemplating a trip, any portion of which can be made over the Chicago & Alton, it will pay you to write to the undersigned for maps, pamphlets, rates, time tables, etc.

B. L. McCLAIN, General Eastern Passenger Agent, 261 Broadway, NEW YORK, N. Y.

JAMES CHARLTON, General Passenger and Ticket Agent, CHICAGO, ILLINOIS.

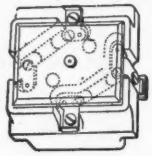
THERE ARE MORE

C.-H. RHEOSTATS

IN USE THAN ALL OTHER MAKES COMBINED.

THE CUTLER-HAMMER MFG. CO., 72 W. Jackson Blvd., CHICAGO, ILL.

The Largest Manufacturers of Rheostats in the World.



MAKING CUT-OUTS OUR SPECIALTY

Write for full particulars, etc. 36 styles of Open and Covered.

CUT-OUTS

Money saved is money earned.

H. T. PAISTE CO.

CHICAGO PHILADELPHIA

DESIGNERS AND ENGRAVERS

BY ALL METHODS

Electrical Machinery and Apparatus A SPECIALTY

GET OUR PRICES AND SPECIMENS BEFORE BUYING.

THE BROWN-BIERCE COMPANY.

DAYTON, OHIO.

Porcelain Manufactory.

EMPIRE CHINA WORKS,

144-156 Greene Street, Station C,

BROOKLYN, N. Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS, Etc.

NAME—— **Electrical Review**

WHEN WRITING TO ADVERTISERS.

CURVES FROM THE STATION OF THE BARRE-MONTPELIER TRACTION CO., MONTPELIER, VT.,

EQUIPPED WITH

Chloride Accumulators.

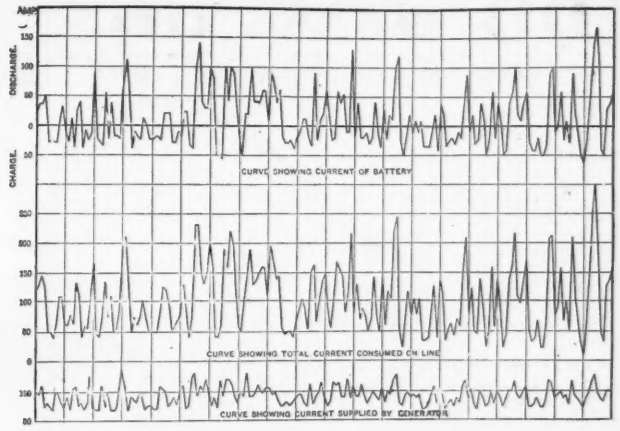
Maximum load on the line ..... 300 Amperes.
" " " " generator.. .... 125 "
The Battery supplies the excess..... 175 "
Variation of load on the line..... 290 "
" " " " " generator.... 50 "

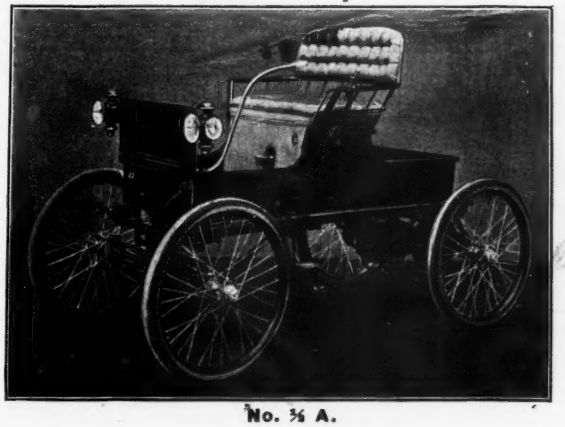
The Electric Storage Battery Co.,

DREXEL BUILDING, PHILADELPHIA, PA.

SALES OFFICES:

New York, 20 and 22 Broad St.
Boston, 60 State St.
Baltimore, Equitable Bldg.
Cleveland, O., Room 914, New England Bldg.
Chicago, Marquette Bldg.
San Francisco, The Parrott Bldg.
Canada, The Canadian General Electric Co. (Limited) Toronto, Ont.


DISCHARGE
CHARGE
CURVE SHOWING CURRENT OF BATTERY
CURVE SHOWING TOTAL CURRENT CONSUMED ON LINE
CURVE SHOWING CURRENT SUPPLIED BY GENERATOR



No. ½ A.

THE WOOD ELECTRIC

MOTO-VEHICLES.

SEND FOR "SPECIALLY FINE" CATALOGUE.

AMONG OTHER THINGS WE GUARANTEE ARE:

That the material and workmanship in the vehicle shall be of the very best, including rubber tires and ball-bearing axles.
That for a period of one year the Company will replace, free of charge, any broken parts due to defective material or faulty shop construction.
That the vehicle shall have, on a level hard roadway, a mileage capacity in one charge of the batteries that will carry its given load twenty five miles at an average speed of twelve and one-half miles per hour, two hours.
That the batteries can be charged when fully discharged in two and one-half hours' time.
That the vehicle shall be capable of climbing a six per cent grade with given load when batteries are reasonably well charged.
That for the sum of $50.00 per annum, the Company will furnish all parts for keeping batteries in perfect repairs for a period of five (5) years, leaving them at the end of the five years in good condition for operation during the ensuing year.

AVERAGE COST TO RUN PER MILE, 3-4 CENT.

FISCHER EQUIPMENT CO.,

110-112 East Twentieth St., CHICAGO, ILL., U. S. A.

$15.00 List.

A Good Instrument

FOR SMALL PLANTS.

HANDSOME AND ACCURATE.

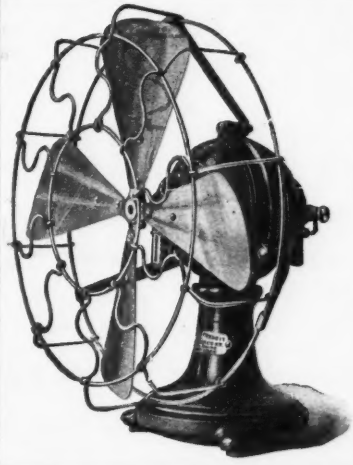
Made for Direct or Alternating Current.

WHITNEY ELECTRICAL INSTRUMENT COMPANY.

MACHADO & ROLLER,

GENERAL SELLING OFFICE,

203 Broadway, N. Y. City.



LUNDELL

FAN MOTORS

For 1899.

ILLINOIS ELECTRIC COMPANY,

Exclusive CHICAGO AGENTS,

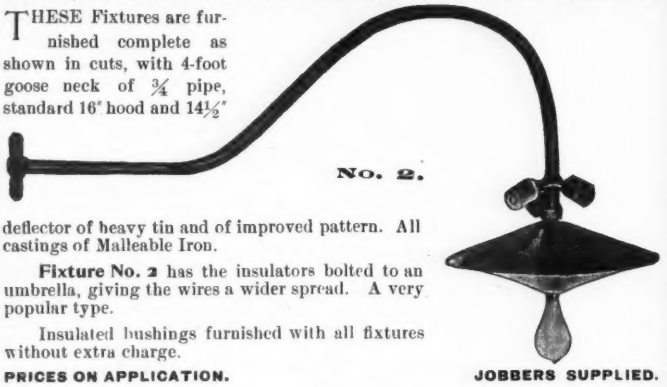
239 Madison St., CHICAGO.

Flickering of lights usually occurs when the station is being crowded. It is self-evident that this flickering is caused by the slipping of belts, and as a belt full of Cling-Surface runs steadily and positively beyond all possibility of slipping, the importance of this fact can be readily seen.

CLING-SURFACE MFG. CO., 178-184 Virginia St., Buffalo, N. Y.

B. W. CO.
STANDARD STREET FIXTURES

THESE Fixtures are furnished complete as shown in cuts, with 4-foot goose neck of ¾ pipe, standard 16" hood and 14½"



No. 2.

deflector of heavy tin and of improved pattern. All castings of Malleable Iron.

Fixture No. 2 has the insulators bolted to an umbrella, giving the wires a wider spread. A very popular type.

Insulated bushings furnished with all fixtures without extra charge.

PRICES ON APPLICATION. **JOBBERS SUPPLIED.**

BIBBER-WHITE COMPANY, Manufacturers,
49 Federal Street, BOSTON.

Steel Outlet and Junction Boxes,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, Etc.
MADE BY
THE BOSSERT ELECTRIC CONSTRUCTION CO.
UTICA, N. Y.

SAFETY TRADE MARK

RUBBER COVERED
WIRES AND CABLES FOR EVERY SERVICE.

For Underground, Aerial and Submarine use, "Safety" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.

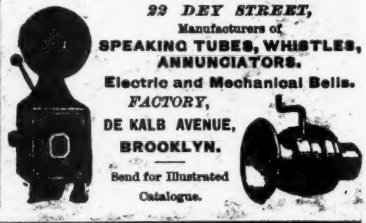
THE SAFETY INSULATED WIRE & CABLE CO.,
225 to 239 West 28th Street, New York.
LEONARD F. REQUA, General Manager.

FARADAY CARBON COMPANY,
ELECTRIC LIGHT CARBONS
JEANNETTE, PA.

Central Manufacturing Co.

Chattanooga, Tenn.
Manufacturers and Dealers in
Yellow Pine Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.
Large stocks on hand. Delivered prices quoted, F. O. B. cars, your city, in any quantity. ☞ Write us.

W. R. OSTRANDER & CO.
99 DEY STREET,
Manufacturers of
SPEAKING TUBES, WHISTLES, ANNUNCIATORS.
Electric and Mechanical Bells.
FACTORY,
DE KALB AVENUE, BROOKLYN.



Send for Illustrated Catalogue.

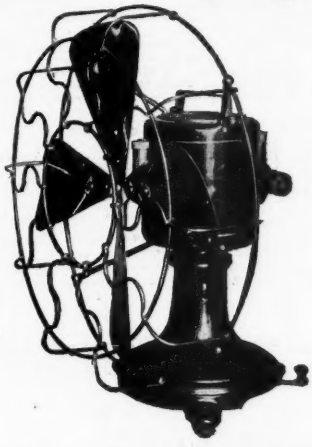
The Monarch Engine-Stop
—with Speed-Limit

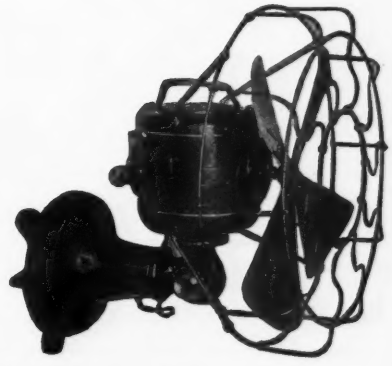
attachment will positively prevent an engine from running away, and also enable it to be stopped from any point in the factory in case of accident, notifying the engineer at the same time. It is a first-class insurance at a low cost. It closes the Throttle-Valve. Why not investigate?

The Monarch Manufacturing Co.,
WATERBURY, CONN.

1899. PARAGON FANS. 1899.

BETTER THAN EVER (IF POSSIBLE).





The only FAN MOTOR that is sold in carload lots. Handled by all leading Supply Houses.

1899 CATALOGUE NOW READY.

Our new Ceiling Fan defies competition and the price is lower than anything on the market. All our goods can be seen at our New York salesroom. Don't fail to get Paragon prices before placing orders.

Western Office: 1012-13 Monadnock Block, CHICAGO.

PARAGON FAN & MOTOR CO., 39-41 CORTLANDT ST., NEW YORK. Telephone 3893 Cort.

Eastern Agents for Emerson Alternating Fans and Power Motors.

When You Want To Know

The names and location of the ELECTRIC LIGHTING CENTRAL STATION COMPANIES throughout the country,
Names of their officials,
Their capital stock and bonded indebtedness,
The number and kind of dynamos used, with the names of makers,
Voltage of the different circuits,
Frequency of alternating current,
Number and kind of arc and incandescent lights,
Style of lamp sockets,
Whether power or day circuits are operated,
The capacity of power plant, including engines, boilers and turbines, with the makers' names,

Please Remember

that all this information is given, fresh and up to date, ONLY in the

American Electrical Directory and Buyers' Manual.

Corrected and issued four times a year. Subscription, $4.
Subscription with AMERICAN STREET RAILWAY DIRECTORY, also issued quarterly, $5.

E. L. POWERS & CO., Publishers,

150 Nassau Street, New York.
Monadnock Block, Chicago.

BRASS SOCKET CAUSES DEATH.

Engineer Electrocuted.

SEATTLE, WASH., October 14th.—Louis Kayazer, an engineer at the Seattle Steam Laundry, was electrocuted today. Kayazer was changing a small globe from one socket to another, and his hand came in contact with the socket. Death resulted in a few minutes.

SALT LAKE CITY, UTAH, Oct. 30, 1898.

Pass & Seymour, Syracuse, N. Y.,

GENTLEMEN:—I enclose you a copy of a press dispatch which was published in the local papers here a few days ago. It is a strong recommendation in favor of your porcelain socket, for had they been in use in this instance one man would not have been called to an untimely end. The enclosed copy is exactly as published.

Very truly yours,

[Signed] E. I. HOLDING.

INDEX OF ADVERTISERS.

PAGE

A

Allen & Co., L. B. xviii
American Battery Co. .....
American Bell Telephone Co. xxvi
American Electrical Heating Co. xx
American Electric Telephone Co., long-distance telephones. xxvi
American Electrical Directory xv
American Electric Vehicle Co. i
American Electrical Works, insulated wire. i
American Engine Co. xxi
American School of Correspondence xix
American Vitrified Conduit Co. i

B

Babcock & Wilcox Co. xxviii
Baker & Co., platinum xviii
Ball & Wood Co., engines xxi
Barnes Co., The Wallace xii
Barron & Co., James S. xx
Bates, D. L., & Bro. iv
Becker Name Plate Co. i
Bibber-White Co xiv
Biddle, James G. xxiii
Bogart Co., A. L. xxiii
Boker & Co., Hermann xii
Bossert Electric Construction Co. xiv
Brady, T. H. xii
Bristol Co. i
Brown-Bierce Co xii
Buckeye Electric Co. xi
Bunnell & Co., J. H., dry batteries xi

C

Cary Spring Works xii
Central Electric Co., electrical supplies iii
Central Manufacturing Co. xiv
Chicago & Alton R. R. xii
Cling-Surface Mfg. Co xiii
Columbia Incandescent Lamp Co. ....
Connecticut Telephone and Electric Co. xxiii
Crefeld Electrical Works i
Crocker-Wheeler Electric Co. i
Cutler-Hammer Manufacturing Co. xii

D

De Veau & Co. xxiv
Diehl Manufacturing Co. iv
Dixon, Jos., Crucible Co., belt dressing. xii
Duval, E. S., Jr., patents xix

E

Edison, Thos. A., Jr. ....
Eastern Electric Cable Co. ix
Edison Manufacturing Co. .....
Edison Decorative and Miniature Lamp Department ix
Electric Appliance Company, supplies i
Electrical Exhibition Co. .....
Electric Storage Battery Co. xiii
Electrical Engineer Institute of Correspondence Instruction xix
Electrical Engineering Publishing Co. xxiii
Emerson Electric Manufacturing Co. iv
Empire China Works, porcelain specialties. xii
Ericsson Telephone Co. i
Eureka Electric Co. xxv

F

Farr Telephone and Construction Co. xxvi
Faraday Carbon Co., carbons xiv
Fischer Equipment Co xiii
Forest City Electric Works xvii
Frink, I. P. xxviii

G

G. & E. Electric Co. xi
Garton-Daniels Electric Co. xviii
Garvin Machine Co. xi
General Electric Co. vii
General Incandescent Arc Lamp Co. ix
Gilmore Electric Co. xvii
Goldmark & Wallace i
Gordon, A. Y. xxiv
Greene, B. E. xx

H

Hart & Hegeman, electric switches iv
Helios Electric Co. .....
Hobart Electric Manufacturing Co. x

I

Illinois Electric Co. xiii
Incandescent Lamp Manipulator Co. ix
India Rubber and Gutta Percha Insulating Co. vi
Indiana Rubber and Insulated Wire Co. .....
International Correspondence Schools xix
Ironclad Resistance Co. xx

J

Jandus Electric Co. ....
Jones, J., & Son xxviii

K

Kartavert Manufacturing Co. xviii
Keystone Electrical Instrument Co. xviii
Kirmayer & Oelling xx

L

Large & Co x
La Roche & Co., F. A. xx
Leffel & Co., James xxi
Lincoln Electric Co. xx
Lombard Water-Wheel Governor Co. xxi
Lynn Incandescent Lamp Co xviii

M

Machado & Roller xiii
Manhattan Electrical Supply Co. xxv
Manross, F. A. xii
Marietta Manufacturing Co. xvii
Marshall, Wm., condensers xxvi
McCay Engineering Co. xxviii
McIntire Co., The C. .....
McLeod, Ward & Co. xiii
Mianus Electric Co. xxiii
Monarch Manufacturing Co. xiv
Montauk Multiphase Cable Co. ..... i, viii
Munsell & Co., Eugene xii
Murdock & Co., Wm. J. xxvi

N

National Automatic Telephone Co. xxiii
National Carbon Co. .....
National Conduit & Cable Co. i
National India Rubber Co. .....
New England Engineering Co. vi
New York & Ohio Co. i
New York Insulated Wire Co., Grimshaw wires and cables i
New York Telephone Co xxvi
North Electric Co. ix
Novelty Electric Co., supplies x

O

Ohio Electric Specialty Manufacturing Co. x
Ohio Electric Works xxviii
Okonite Co., insulated wires and cables ..... i, xxviii
Ostrander, W. R., & Co., supplies xiv
Orient Electrical Co. .....

P

Paiste, H. T., Co. xii
Palmer Bros. xxvi
Paragon Fan and Motor Co. xv
Partrick, Carter & Wilkins ....
Pass & Seymour xv
Pelton Engineering Co. xxi
Pettingell-Andrews Co ....
Philadelphia Book Co. ix
Phœnix Carbon Manufacturing Co. .....
Phœnix Glass Co. i

R

Reisinger, Hugo ....
Reliable Electric Manufacturing Co. xxiii
Ritchie & Sons xi
Robbins & Myers Co., The vii
Roche, Wm. xii
Roebling's Sons Co., John A. xxviii

S

Safety Insulated Wire & Cable Co. xiv
Samson Cordage Works xxviii
Sawyer-Man Electric Co. .....
Schiff, Jordan & Co. xvii
Shelby Electric Co. i
Simplex Electrical Co. i
Sprague Electric Co. viii
Standard Thermometer & Electric Co. iii
Standard Paint Co. xviii
Standard Underground Cable Co. i
Stanley & Patterson ix
Sterling Supply & Manufacturing Co. v
Stirling Co., water-tube boilers xxi
Stromberg-Carlson Telephone Mfg. Co. xxvi

T

Taber & Mayer xxiii
The Telephone Manufacturing Co. xxv
Thornberry, Henry S. xix

U

United Correspondence Schools xix
United States Battery Co. .....
U. S. Desk & File Co xii
U. S. Mineral Wool Co xxviii

V

Van Nostrand Co., D ....
Viaduct Mfg. Co., telephones, etc. xxvi
Victor Telephone Manufacturing Co. xxv

W

Wanted xx
Ward Leonard Electric Co. xx
Warren Electric & Specialty Co. i
Wells, Heber xx
Western Electric Co. v
Western Telephone Construction Co. xxiii
Westinghouse Electric & Mfg. Co. vi
Williams-Abbott Electric Co. xxiv
Williams Electric Co. xxiv
White & Co., J. G., engineers and contractors xx
Whitman & Couch ii
Whitney Electrical Instrument Co. xiii
Wyckoff Creosoting Co. xviii

Y

Young, W. C., Mfg. Co. xi

CLASSIFIED LIST.

Alternators.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Arc Lamps. (See "Lamps.")

Batteries, Primary.
Bunnell & Co., J. H.
Manhattan Electrical Supply Co.
Peru Electric Mfg. Co.
Roche, Wm.
Thermo-Electric Co.

Batteries, Storage.
American Battery Co.
Electric Storage Battery Co.
Sipe & Sigler.

Battery Material.
Bunnell & Co., J. H.

Bells.
Holtzer-Cabot Electric Co.
Ostrander & Co., W. R.

Belts.
Cling-Surface Mfg. Co.

Belt Dressing.
Cling-Surface Mfg. Co.
Dixon Crucible Co., Joseph.

Boilers.
Babcock & Wilcox Co., The
Stirling Co., The

Books, Technical.
Electrical Review Pub. Co.
Philadelphia Book Co.
Van Nostrand Co., D.

Bridges, Floors, Cranes (Iron).
Berlin Iron Bridge Co.

Brushes, Dynamo.
Crown Woven Wire Brush Co.
Goldmark & Wallace.
Hobart Electric Mfg. Co.
Ohio Electric Specialty Mfg. Co.

Buildings and Roofing (Iron).
Berlin Iron Bridge Co.

Cable Hangers.
Standard Underground Cable Co.

Carbon Points.
Faraday Carbon Co.
National Carbon Co.
Phœnix Carbon Mfg. Co
Reisinger, Hugo.

Castings.
Bubier Electric Co.

Circuit Breakers.
La Roche & Co., F. A.
Ward Leonard Electric Co.

Climbers.
Barron & Co., Jas. S.
Klein & Son, Mathias.

Coal Mining Machinery.
General Electric Co.

Commutator Bars and Repairing.
Forest City Electric Works.

Commutator Lubricant.
Ohio Electric Specialty Mfg. Co.

Condensers (Electric).
Marshall, Wm.

Conduits.
American Vitrified Conduit Co.
National Conduit & Cable Co.
Wyckoff Creosoting Co.

Connectors and Terminals.
McIntire Co., The C.

Copper Gaskets.
U. S. Mineral Wool Co.

Cord, Electric.
Samson Cordage Works.

Desk Lamps.
McLeod, Ward & Co.

Dynamos and Motors.
Central Electric Co.
Crocker-Wheeler Electric Co.
Eddy Electric Mfg. Co.
General Electric Co.
Hobart Electric Mfg. Co.
Illinois Electric Co.
Lincoln Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Locomotives.
General Electric Co.

Electric Novelties.
Barron & Co., James S.
Ohio Electric Works.

Electric Heaters.
American Electrical Heater Co.

Electrical Instruments.
Biddle, James G.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
Keystone Electrical Instrument Co.
Whitney Electrical Instrument Co.

Electric Soldering Irons.
American Electrical Heating Co.

Electrical Supplies.
Bibber-White Co.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Appliance Co.
Holtzer-Cabot Electric Co.
Illinois Electric Co.
Jones, J., & Son.
Manhattan Electrical Supply Co.
Novelty Electric Co.
Ohio Electric Works.
Partrick, Carter & Wilkins.
Western Electric Co.

Engineers and Contractors.
McCay Engineering Co.
New England Engineering Co.
White & Co., J. G.

Engines.
American Engine Co.
Ball & Wood Co.
Monarch Mfg. Co.

Fans and Fan Motors.
Bates, D. L., & Bro.
Central Electric Co.
Diehl Mfg. Co.
Edison Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
Illinois Electric Co.
Marietta Mfg. Co.
Paragon Fan & Motor Co.
Robbins & Myers Co., The
Warren Electric & Specialty Co.

Fiber.
Kartavert Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.

Gas-Lighting Apparatus.
Bogart Co., A. L.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.
Partrick, Carter & Wilkins.

Incandescent Lamps.
(See "Lamps.")

Instruments (Testing and Recording.)
Biddle, Jas. G.
Bristol Co., The
General Electric Co.
Machado & Roller.
Keystone Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Kartavert Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Junction Boxes.
Bossert Electric Construction Co.
Ward Leonard Electric Co.

Lamps, Arc.
Central Electric Co.
Diehl Mfg. Co.
General Electric Co.
General Incandescent Arc Lamp Co.
Helois Electric Co.
Jandus Electric Co.
Standard Thermometer & Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative.
Central Electric Co.
Edison Decorative & Miniature Lamp Co.

Lamps, Incandescent.
Barron & Co., Jas. S.
Buckeye Electric Co.
Columbia Incandescent Lamp Co.
Edison Decorative & Miniature Lamp Co.
Edison, Jr., Thos. A.
General Electric Co.
Gilmore Electric Co.
Improved Electric Glow-Lamp Co., Ltd.
Lynn Incandescent Lamp Co.
New York & Ohio Co.
Ohio Electric Works.
Sawyer-Man Electric Co.
Shelby Electric Co
Warren Electric & Specialty Co.
Westinghouse Electric & Mfg. Co.

Lathes.
Garvin Machine Co.

Lightning Arresters.
Garton-Daniels Electric Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Machine Tools.
American Tool Works Co.
Garvin Machine Co.

Mast-Arms.
Brady, T. H.

Mica.
Munsell, Eugene.
Sills Mica Co., W. H.

Name Plates.
Becker Name Plate Co.

Paint.
Standard Paint Co.

Patent Solicitors.
Duvall, Edw. S.
New York Patent Bureau.
Thornberry, Henry S.
Woltereck, Herman C.

Pattern Letters.
Wells, Heber.

Platinum.
Baker & Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.
Locke, Fred M.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.
Roebling's Sons Co., John A.

Railway Specialties (Electric)
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.

Rheostats.
Cutler-Hammer Mfg. Co.
Ohio Electric Specialty Mfg. Co.
Ward Leonard Electric Co.

Schools.
American School of Correspondence.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools.
United Correspondence Schools.

Securities.
Greene, B. E.

Soldering Sticks.
Allen & Co., L. B.

Specialties.
Barron & Co., Jas. S.
G. & E. Electric Co.
Ohio Electric Works.

Steam Engine Stops.
Monarch Mfg. Co.

Steel Spring Wire.
Boker & Co., Hermann.
Carey Spring Works
Manross, F. A.
Wallace Barnes Co.

Storage Batteries.
Electric Storage Battery Co
Sipe & Sigler.

Switchboards.
American Electric Telephone Co.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
Large & Co.
Western Electric Co.
Western Telephone Construction Co.

Switches, Etc.
Central Electric Co.
General Electric Co.
General Incandescent Arc Lamp Co.
Hart & Hegeman Mfg. Co.
Jones & Son, J.
Large & Co.
La Roche & Co., F. A.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Bunnell & Co., J. H.
Central Electric Co.
Connecticut Telephone & Electric Co.
De Veau & Co.
Eureka Electric Co.
Farr Telephone and Construction Co.
Gordon, A. Y.
Holtzer-Cabot Electric Co.
Illinois Electric Co.
Manhattan Electrical Supply Co.
Mianus Electric Co.
Murdock & Co., Wm. J.
National Automatic Telephone Co.
New York Telephone Co.
North Electric Co.
Ohio Electric Works.
Pennsylvania Electric Co.
Reliable Electric Mfg. Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg. Co.
Telephone Mfg. Co.
Viaduct Mfg. Co.
Victor Telephone Mfg. Co.
Western Electric Co.
Western Telephone Construction Co.
Williams-Abbott Electric Co.
Williams Electric Co.

Tools.
American Tool Works Co.
Garvin Machine Co.

Transformers.
New York & Ohio Co.
Westinghouse Electric & Mfg. Co.

Turbine Governors.
Lombard Water-Wheel Gov. Co.

Water-Wheels.
Leffel & Co., Jas.

Wires and Cables.
American Electrical Works.
Central Electric Co.
Crefeld Electrical Works.
Eastern Electric Cable Co.
Electric Appliance Company.
General Electric Co.
Indiana Rubber and Insulated Wire Co.
India Rubber & Gutta Percha Insulating Co.
Montauk Multiphase Cable Co.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Novelty Electric Co.
Okonite Co., The.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Taber & Mayer.
Western Electric Co.

X-Ray Apparatus.
Kirmayer & Oelling.
Ritchie & Sons.

Gilmore Lamps and Rosettes

Highest Quality. Lowest Prices.

Large Stock.

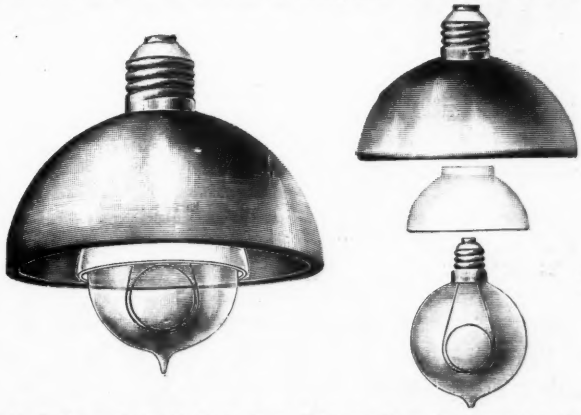
GILMORE ELECTRIC CO.,

M and 1st Streets, SO. BOSTON, MASS.

N. B.

You can exchange your burned-out lamps and bases without expense for strictly new lamps.

WRITE FOR PARTICULARS.



SOMETHING NEW!

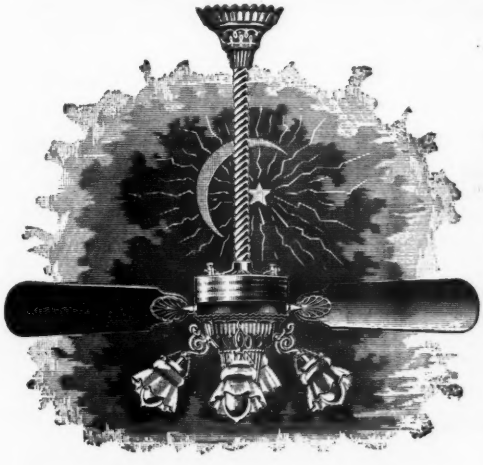
THE "S. J." REFLECTOR SHADE

Increase and properly diffuse your light by using the "S. J." REFLECTOR SHADE. No shade-holder necessary. Screws directly in the socket.

WRITE FOR DESCRIPTIVE PRICE LIST SUPPLY DEPARTMENT.

SCHIFF, JORDAN & CO.,

232 GREENWICH ST., NEW YORK.



THE NEW CRESCENT FANS.

These Fans ARE POSITIVELY without the humming noise so frequent with other Fans. We will place these in competition with any others manufactured. OBSERVE NEW BLADES, swivel joint furnished with each. Address,

MARIETTA MANUFACTURING CO.,

MARIETTA, PA.

ELECTRICAL BOOKS

A specialty of the ELECTRICAL REVIEW.

Orders promptly filled. 41 Park Row, New York.

SEND FOR "ELECTRICITY AND WATER-POWER"—PRICE, $1.00.

PLATINUM

IN SHEET OR WIRE, ANY SIZE, SHAPE OR DEGREE OF HARDNESS, FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. RAILROAD AVE., NEWARK, N. J.

NEW YORK OFFICE, 120 LIBERTY STREET.

Scrap and Native Platinum Purchased.

SWITCHBOARD VOLTMETERS

Ammeters, Ground Detectors and Differential Voltmeters.

TYPE "R."

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating-current circuits.

Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.

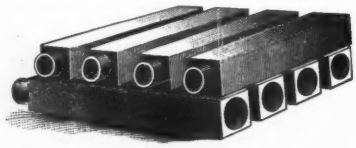
We also manufacture a full line of Portable Instruments. Send for our complete catalogue.

Keystone Electrical Instrument Co.,

Ninth Street and Montgomery Avenue,

PHILADELPHIA.

NEW YORK, 15 Cortlandt Street. CHICAGO, 231 S. Canal Street.



THE WYCKOFF CREOSOTING CO.,

WILLIAMSPORT, PA.

MANUFACTURERS OF

WYCKOFF WOODEN CONDUITS,

Also Poles and Cross-Arms.

THE ALLEN SOLDERING STICK

Non-Corrosive, Convenient, and Effective

A SUBSTITUTE FOR RESIN, ACIDS, AND SOLDERING SALTS.

FOR ALL ELECTRIC WORK.

MANUFACTURED EXCLUSIVELY BY

L. B. ALLEN CO.,

6359 STAR AVE., CHICAGO, ILL., U. S. A.

THE STANDARD

P AND B

ELECTRICAL COMPOUNDS.

ARMATURE AND FIELD-COIL VARNISH.

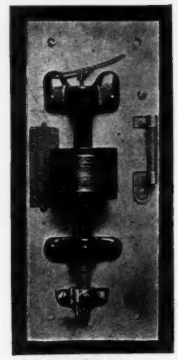
INSULATING TAPE.

RUBEROID MOTOR CLOTH.

MANUFACTURED BY

The Standard Paint Company,

Chicago Office, 189 Fifth Avenue. 81-83 JOHN STREET, N. Y. Write for Particulars.



GARTON LIGHTNING ARRESTERS

Don't Get Sick.

Their health keeps your machinery healthy, and this is worth more to you than the price of a complete outfit.

For Prices and New Catalogue, address your Supply Dealer or

GARTON-DANIELS ELECTRIC COMPANY

KEOKUK, IOWA, U. S. A.

KARTAVERT

FIBER! FIBER! FIBER!

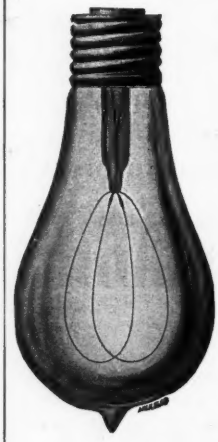
HARD AND FLEXIBLE. IN SHEETS, RODS AND TUBING.

For ELECTRICAL and Mechanical purposes, Railway dust guards, Washers and packings.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO., Wilmington, Del.

P. O. BOX 625.



LYNN LAMP.

OVAL ANCHORED FILAMENT.
EXTRA SHORT BASE.
UNIFORM MOULDED BULBS.

The MOST SYMMETRICAL RELIABLE EFFICIENT CAREFULLY MADE AND TESTED LAMP ON THE MARKET.

All Candle-Powers, Voltages and Efficiencies.

LARGE STOCK.
PROMPT SHIPMENTS.
GOODS GUARANTEED.

WRITE FOR PRICES.

LYNN INCANDESCENT LAMP CO., LYNN, MASS.

FOREST CITY ELECTRIC CLEVELAND O. **ROLL DROP** COMMUTATOR BARS HAVE STOOD THE TEST OF TIME

THE BALL & WOOD HIGH-SPEED ENGINE

is noted for its smooth and silent running, and its extremely low cost of maintenance. It is recognized as the standard engine for electric light and railway plants. Ball & Wood engines are made in all types for all services requiring the best economy and efficiency.

THE BALL & WOOD CO.,

Works, Elizabethport, N. J. 120 LIBERTY ST., NEW YORK CITY.

LOOK AT THESE PRICES FOR ELECTRICAL MACHINERY.

Samples from our BARGAIN COUNTER, showing a part of the second-hand stock now in our shops, and the prices we make.

1 40 K.-W. Westinghouse Multipolar Generator, 500 volts, late type, fine condition. Warranted.. ..... $425 00

1 45 K.-W. Edison, 125 volts, late type, ring oiler, with oak sub-base, nearly new. Warranted 465 00

1 20 K.-W. Western Electric, 110 volts, ring oiler, self-aligning bearings, medium speed nearly new Warranted..... ..... 295 00

1 8 K.-W. National, 110 volts, overhauled and warranted 165 00

1 MD 2, T.-H. Arc Dynamo, 50-light, 2,000 candle-power. Overhauled and warranted... .... $400 00

1 Extra Ring Armature, for T.-H. MD 2 .... 135 00

1 M 12, T.-H. Arc Dynamo, 45-light, 1,200 candle power. Overhauled and warranted..... .... 235 00

1 LD 2, T.-H. Arc Dynamo, 35-light, 2,000 candle-power. Overhauled and warranted..... .... 225 00

1 No. 7, Brush Arc Dynamo, 30-light, 2,000 candle-power. Overhauled and warranted..... $225 00

All machines complete with sub-base and controlling devices We have over FIFTY DYNAMOS and close to ONE THOUSAND ARC LAMPS, ready for immediate delivery.

THE PELTON ENGINEERING CO., 1076 HAMILTON ST., CLEVELAND, OHIO.

We are constantly installing new apparatus and displacing old—so have many varieties of dynamos, motors, lamps and various electrical equipments always in stock. It is a principle of our business that all stock must be thoroughly overhauled before shipment, so that we can warrant all sales.

WATER WHEELS

For Heads of 3 Feet to 2000 Feet.

Especially adapted to all kinds of

ELECTRIC POWER AND LIGHTING PLANTS.

Recent tests at Holyoke, given below, enable us to guarantee: *The Largest Power ever obtained from a wheel of the same diameter. The highest speed ever obtained for the same power. The highest mean efficiency when running from half to full gate.* We guarantee also: *A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing*

Test of a 45 in. SAMSON, Jan. 25, '97.						Test of a 35 inch SAMSON, Feb. 1, '97.					
Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.	Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03	Full	15.29	194 25	102.02	143.44	81.08
7/8	15.04	138.12	155.03	223.61	84 55	7/8	16.56	187.75	92.15	146.73	84.78
3/4	15.11	127.67	133.24	191.06	83.68	3/4	17.33	178.50	83.95	138.40	83.88
5/8	15.88	131.50	112 65	162.80	80 35	5/8	17.54	176.40	68.82	109.64	80.09
1/2	16.47	126.87	90.04	127.73	75.95	1/2	17.68	168.50	57.69	88.14	76.19

JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

CAN WATER-WHEELS BE GOVERNED?

If you will give us a description of your water-wheels and how they are set, we can refer you to a plant similarly arranged, where our governors are in use. Our governors are now being used to regulate over

SEVENTY-FIVE THOUSAND HORSE-POWER

of water-wheels in this country alone. We sell our governors with a

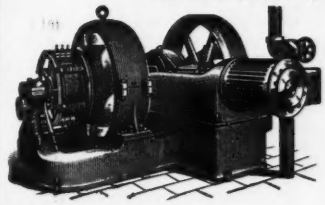
POSITIVE GUARANTEE

that they will give a better speed regulation than any other make of governor.

LOMBARD WATER-WHEEL GOVERNOR CO.,

61 Hampshire Street (Roxbury District), BOSTON, MASS.

AMERICAN-BALL ENGINES and ELECTRIC MOTORS and GENERATORS



BOTH

BELTED and DIRECT-CONNECTED.

AMERICAN ENGINE CO.,

48 RARITAN AVE., BOUND BROOK, N. J.

New York Office, 97 Liberty St.

THE STIRLING WATER TUBE SAFETY BOILER

SAFE, EFFICIENT, DURABLE.

Over 500,000 H.-P. in Use.

All wrought metal; no flat surfaces or stay bolts; four manholes give access to every tube. Quick and steady steam and thorough circulation guaranteed.

THE STIRLING COMPANY,

PULLMAN BUILDING, CHICAGO, ILL.

New York Office, - - - 95 Liberty Street
Philadelphia Office, - - - Betz Building
Boston Office, - Room 17, 19 Pearl Street

IMPORTANT BOOKS NOW READY

ELECTRICITY MADE EASY

By SIMPLE LANGUAGE and COPIOUS ILLUSTRATION.

By Edwin J. Houston, A. M., Ph. D., and Arthur E. Kennelly, Sc. D.

CHAP. **TABLE OF CONTENTS:**

I. The Turning of an Electric Lamp in the House.
II. How the Electric Wires are Distributed Through the House.
III. How the Electric Street Mains Supply the House.
IV. How the Street Mains are Supplied with Electricity.
V. The Electric Lighting Station.
VI. How the Incandescent Lamp Operates.
VII. How the Incandescent Lamp is Made.
VIII. How the Electric Current Supplied to the House is Measured.
IX. How the Arc Lamp Operates.
X. How the Light of Electric Lamps is Best Distributed.
XI. The Voltaic Cell and How it Operates.
XII. The Electric Bell and How it Operates.
XIII. The Electric Telegraph and How it Operates.
XIV. How the Dynamo Operates.
XV. How the Electric Motor Operates.
XVI. The Telephone and How it Operates.
XVII. Some Other Applications of Electricity.

The authors have taken great pains to tell the story of Electricity in a clear, comprehensive style, so that beginners and laymen can not fail to be greatly benefited by reading this new work.

Many analogies are given which simplify what is usually a difficult technical subject. The authors are famous for their ability in explaining technical matters without the use of the higher mathematics. Whether you make the science of electricity your profession or not, much knowledge can be gained by reading this work, as it gives any one a clear idea of the application of electricity.

Every reader of Meadowcroft's A B C of Electricity should read this new work. These two books are the best elementary works published.

1 Vol., 18 mo, Cloth, over 250 Illustrations and 350 Pages, $1.50.

Sent postpaid on receipt of price.

64th Thousand in Press.

A B C OF ELECTRICITY

BY WILLIAM H. MEADOWCROFT.

Indorsed by THOS. A. EDISON.

This excellent primary book has taken the first place in elementary scientific works. It has received the indorsement of Thomas A. Edison. It is for every person desiring a knowledge of electricity, and is written in simple style so that a child can understand the work. It is what its title indicates, the first flight of steps in electricity.

WHAT THE PRESS SAYS:

"A clear and comprehensive little treatise."—*N. Y. Sun.*

"Electric science is making magnificent strides, and this book fills a useful office in setting forth the features and characters of these advances."
—*Brooklyn Times.*

"The need of such a book has undoubtedly been felt by many . . . we predict for it a splendid sale."—*The Age of Steel.*

"A book like this should be largely read."—*N. Y. Herald.*

"The book is well illustrated and no pains have been spared to make it accurate and reliable throughout."—*Electrical Review.*

"In simple language the author lays bare the secrets of electrical science and application."—*The Electrical World.*

"A vast amount of useful information."—*Washington Post.*

FROM THE LABORATORY OF THOS. A. EDISON, ORANGE, N. J.

MR. W. H MEADOWCROFT, New York City:

Dear Sir—I have read your MS. of the "A B C of Electricity," and find that the statements you have made therein are correct. Your treatment of the subject and the arrangement of the matter have impressed me favorably.

Yours truly,
THOS. A. EDISON.

108 pp., Illustrated, 12mo, Cloth Binding, 50c.

Sent postpaid on receipt of price.

A MINE OF TECHNICAL INFORMATION

For the Practical Electrician
The Professor
The Student

And ANY ONE interested in ANY WAY in the science.

AN ABSOLUTELY NEW WORK.
COMPLETE AND UNABRIDGED.

The Pocket 4th EDITION Electrical Dictionary

By EDWIN J. HOUSTON, A. M., Ph. D. (Princeton.)

A most valuable contribution to electrical literature.

This new Dictionary is destined to enjoy a worldwide sale. It contains over 11,000 words and about 15,000 definitions used in the science. There are several thousand new words now used in the science that have never appeared in any other single book.

It is indispensable to all electricians.

It is beautifully printed on fine paper, and is so compact that it can be carried in the pocket.

The type is large and clear. 950 Pages.

1 Vol., 32mo, Cloth, $2.50; Leather, $3.00.

Sent postpaid on receipt of price.

The Interpretation OF MATHEMATICAL FORMULÆ

By Edwin J. Houston, A. M., Ph. D., and Arthur E. Kennelly, Sc. D.

With Diagram Illustrations.

A new work for students' use, and to aid all who are educating themselves on the higher mathematics. Invaluable to the Engineer and Electrician.

THE CONTENTS INCLUDE:

CHAP. I.—Addition.
II.—Subtraction.
III.—Multiplication.
IV.—Division.
V.—Involution. Powers.
VI.—Evolution. Roots.
VII.—Equations.
VIII.—Logarithms.
IX.—Trigonometry.
X.—Hyperbolic Trigonometrical Functions.
XI.—Differential Calculus.
XII.—Integral Calculus.
XIII.—Determinants.
XIV—Synopsis of Symbols.

Prof. Forbes, of England, in speaking of Dr. Kennelly's work, says: "Of all the beautiful expositions of profound mathematical work in the simplest language which can be understood by any student in our technical colleges, there is nothing in the literature of the day to come up to the writings of Dr. Kennelly."

1 Vol., 12mo, Cloth, $1.25.

Sent postpaid on receipt of price.

Address: ELECTRICAL REVIEW PUBLISHING COMPANY, TIMES BUILDING, NEW YORK CITY.

WATCH-CASE RECEIVER SWITCH.

Highest Grade Goods Only.

TABER & MAYER CO.

We are manufacturers, and not only sell complete telephones, but everything pertaining thereto. Our special telephone parts, switches, pushes, transmitters and receivers are in great demand, Be sure and get our prices on these parts. especially our three styles of transmitter.

506 Atlantic Avenue,
BOSTON.

TELEPHONES

for Intercommunicating and Exchange Work of the Most Careful Mechanical and Electrical Construction.

SEND FOR CATALOGUE AND PRICES.

RELIABLE ELECTRIC MFG. CO.

WORCESTER, MASS.

TELEPHONE,

as shown in cut, will talk 100 miles.
Price, - $5.00

TWO-CELL, SWINGING-ARM TELEPHONE, . $7.75
HARD RUBBER RECEIVERS, ...65
ELECTROSE RECEIVERS, ...47

Above goods first-class in every respect. Send for catalogue.
Get prices on Batteries.

MIANUS ELECTRIC CO., MIANUS, CONN.

IF THE BEST IS NOT TOO GOOD FOR YOU

YOU WILL BE SATISFIED WITH

The Telephone Magazine

...FOR 1899...

If you are interested in the operation or Construction of **Exchanges, Line Construction, Interior Wiring, Modern Exchange Apparatus, Telephone Troubles** and **How to find them,** or in any other branch of Telephony, send us **A DOLLAR BILL** with your name and address and the Magazine will reach you regularly for a year.

Sample copies free.
Special rates to Agents and Clubs.

Electrical Engineering Publishing Co.

Monadnock Block, CHICAGO.

NEWSDEALERS SELL IT.

McINTIRE'S PATENT

CONNECTORS AND TERMINALS.

Special Connectors for HARD-DRAWN COPPER WIRE, all sizes. FUSED WIRE, FUSED LINKS and STRIPS.

THE C. McINTIRE CO., 13 & 15 Franklin St., NEWARK, N. J.

A. L. BOGART CO.

Electric Gas-Lighting Specialties.

The Bartholdi Automatic Burner
The Bogart Frictional Machines.
Multiple Porcelain Burners.
Dynamo-Electric Gas-Lighting Torches.
Electric Gas-Lighting Attachments for Incandescent Gas Lights.
Rhumkorff Induction Coils.

123 Liberty Street, New York City.

AUTOMATIC TELEPHONE.

We make 20 different styles of telephones. They are easy to operate, require no hello girls.

Reliable and durable.

You can not afford to buy new equipment without first consulting us.

CENTRAL EXCHANGE.

EXAMPLE:

To call
1562,
remove Receiver, turn pointer to 1 and let it return, then to 5, then to 6 and then to 2.

Ring as usual.

The Bell will not ring on a BUSY LINE.

THE NATIONAL AUTOMATIC TELEPHONE CO.,
71-75 West Jackson Boulevard, CHICAGO, and SALINA, KAS

Western Telephone Construction Co.

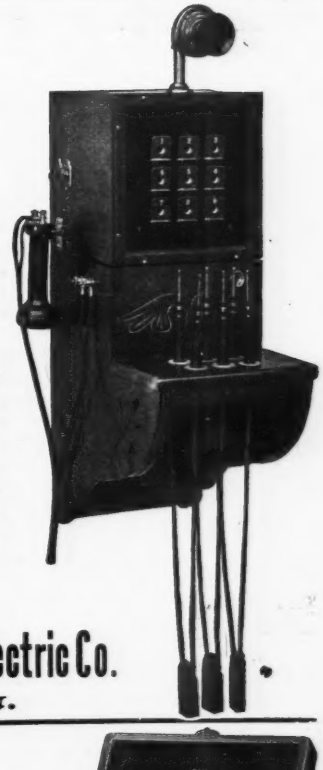
250-254 S. CLINTON STREET, CHICAGO, ILL.

Largest Manufacturers of

TELEPHONES AND SWITCHBOARDS EXCLUSIVELY

IN THE UNITED STATES.

You Need Our Catalogue Number Five.



Descriptive of the most comprehensive and modern line of Telephone apparatus manufactured in the independent field. It shows numerous styles of exchange instruments as adapted for toll line and private installation for various services, desk sets, intercommunicating and factory equipments with several call systems, transmitters, arm transmitters, receivers, watch-case receivers, magneto bells, induction coils, generators, ringers, motor generators, lightning and sneak current arresters, binding posts, telephone batteries, keyboards and switches, extension bells and completely constructed switchboards.

Address

THE Connecticut Telephone & Electric Co.
MERIDEN, CONN.

Apparatus for Testing Cables

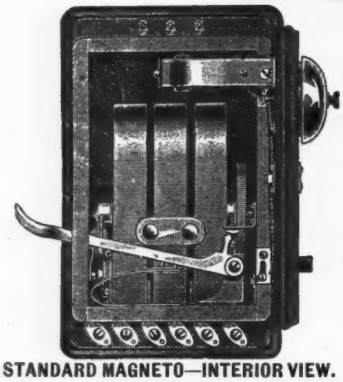
as supplies to U. S. Government, Manufacturers of Cables, Electric Light Stations and the various Telephone Co's.

Send 10 cents for catalogue B. "Electrical Measuring Instruments," recently issued. More than 100 pages, profusely illustrated.

JAMES G. BIDDLE,
1037 Drexel Building, Philadelphia, Pa.

"Jagabi" Portable Testing Set.

A BELL THAT IS A BELL.



STANDARD MAGNETO—INTERIOR VIEW.

THE WILLIAMS-ABBOTT MAGNETO BELL.

Perfect, Electrically and Mechanically.

EVERY ONE GUARANTEED.

Why not get the best when you can get it at cost of poorest.
Our bell will outlive TWO of ordinary kind.

GET OUR PRICES.

Examine and test before closing any contracts.

THE BEST TELEPHONE BELLS AND RECEIVERS ON THE MARKET.

SEND FOR DESCRIPTION AND PRICES.

Correspondence Solicited. Patents Bought and Manufactured on Royalties.

THE WILLIAMS-ABBOTT ELECTRIC COMPANY,

8 10 and 12 Columbus St. CLEVELAND, OHIO.

OUR TESTING BELL.

SAY WHERE you saw the ad.—the advertiser likes to know.

THE NEW GORDON

LONG DISTANCE

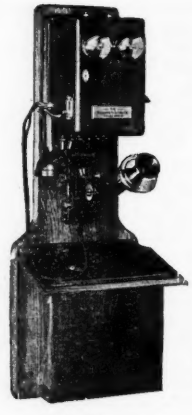
Adjustable Transmitter Arm

Can be raised, lowered or swung laterally, instantly, to suit the user. Transmitter is held in a horizontal position always.

A. Y. GORDON, Patentee and Manufacturer,

MASSILLON, OHIO.

Lowest Price on Market!!



No. 25.

OUR BEST.

Don't Hesitate!

This telephone is fitted with our celebrated

MAGNETO BELL (single-core ringer).
SOLID BACK TRANSMITTER.
EXTRA STRONG D.-P. RECEIVER.

You may be assured that it is as good a telephone as can be manufactured and worthy of your investigation.

Let us have a trial order.

THE WILLIAMS ELECTRIC CO.,

CLEVELAND, OHIO.

Telephone Hand-Book.

BY HERBERT LAWS WEBB.

Chapter 1. The Invention of the Telephone.—Chapter 2. Sound Waves. Articulate Speech.—Chapter 3. Electric Telephony. The Bell Telephone.—Chapter 4. The Microphone.—Chapter 5. Current Induction. Electro-Magnetic Induction.—Chapter 6. The Induction Coil: Its Use in the Telephone Transmitter.—Chapter 7. The Complete Telephone Circuit.—Chapter 8 Magnet Telephones.—Chapter 9. The Bell Telephone Receiver.—Chapter 10. Other Forms of Magnet Telephones.—Chapter 11. The Gower, Ader and D'Arsonval Receivers: Mercadier's Bi telephone.—Chapter 12. The Siemens, Kotyra, Neumayer and Bottcher Receivers.—Chapter 13. Carbon Transmitters.—Chapter 14 The Blake Transmitter.—Chapter 15. The Long-Distance Transmitter.—Chapter 16. The Solid Back Transmitter.—Chapter 17. The Berliner Transmitter.—Chapter 18. The Cuttriss Transmitter.—Chapter 19. Various European Transmitters.—Chapter 20. The Efficiency of Carbon Transmitters.—Chapter 21. Batteries for Telephone Work.—Chapter 22. Open Circuit Batteries.—Chapter 23. Closed Circuit Batteries.—Chapter 24. The Practical Management of Batteries.—Chapter 25. Magneto Bells.—Chapter 26. Automatic Switches.—Chapter 27. Telephone Line Construction.—Chapter 28. Metallic Circuits.—Chapter 29. Underground Wires.—Chapter 30. Lightning Arresters.—Chapter 31. Inside Wiring.—Chapter 32. Installation of Telephone Instruments.—Chapter 33. Inspection and Maintenance.—Chapter 34. The Condenser: Its Use in Telephony.—Chapter 35. Electro-Magnetic Retardation.—Chapter 36. Exchange Working.—Chapter 37. Small Exchanges.—Chapter 38. Party Lines: The Bridging Bell.—Chapter 39. Long Distance Telephony.—Chapter 40. Duplex Telephony.—Chapter 41. Simultaneous Telegraphy and Telephony.—Appendix

A PRACTICAL UP-TO-DATE BOOK. A TIMELY WORK.

Price, $1.00. Postpaid.

SEND YOUR ORDERS TO

ELECTRICAL REVIEW PUBLISHING COMPANY,

TIMES BUILDING, 41 Park Row, NEW YORK.

ADVANTAGE IS MUTUAL when you mention that you saw an advertisement in the ELECTRICAL REVIEW.

TELEPHONES

Over 50 STYLES to select from.

Our 100 Page Catalogues, etc., for the asking.

Reliable information that will start you right and keep you right.

ALL THE LATEST IMPROVEMENTS.

DE VEAU & CO.

26 ROSE STREET, NEW YORK.

IT HAS NO BUGS IN IT.

Do you know of any that as much can be said of. Investigate it.

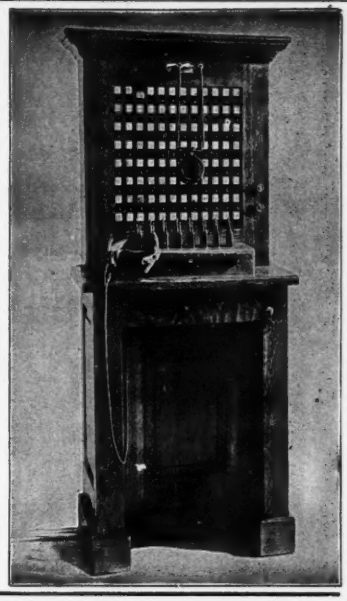
Already installed in a hundred plants.

Its success unequaled.

It is the only board in the market that has supplanted others, and never been supplanted by others.

Can others show this record?

Write for further and fuller particulars.



EUREKA ELECTRIC CO.,
157-59 So. Canal St., Chicago, Ill.

HOW TO WIRE BUILDINGS

The Book for Wiremen, Electrical Engineers, Contractors, Constructing Engineers, Architects and Students. 162 Pages. Illustrated. Price, $1.50. Sent to any address on receipt of price. Electrical Review Pub. Co., 41 Park Row, New York.

The Most Reliable General Telephone Apparatus Manufacturers in the World.

The Victor Apparatus

IS FULLY PROTECTED BY PATENTS.....

We make a full line of Telephone Apparatus.

The Victor Express Switch-board

has no wires running into the back or jacks; all others have from three to six. This board is the most satisfactory ever offered to the telephone public. It is durable and simple, containing no useless trappings or superficial parts. It is durable and simple in construction, easy and rapid to operate and inexpensive to maintain. All parts are interchangeable and accessible without interfering with other parts or interruption of operation. This board is built in sections of five drops and jacks, mounted on hard rubber, invisibly wired and so constructed that when assembled it has the appearance and in fact is one solid front. Each subscriber has an individual ringing key, and the gravity drop used is a special feature owing to its positive action and easy restoration.

Front View, Showing 5 Sections Drops and Jacks.

Back View, Showing 5 Sections Drops and Jacks.

Write for information on telephone instruments.

VICTOR TELEPHONE MANUFACTURING CO., 166-174 So. Clinton Street, CHICAGO.

NOW READY—CATALOGUE No. 10.

NET PRICE, $6.50.

A New Pocket Battery Gauge, to retail **$3.50,** will be ready Nov. 1st.

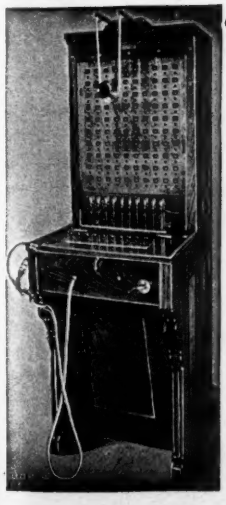
Something New in Burglar-Alarm Traps now ready. A lot of specialties we are now making can be purchased at the right price.

THE MESCO DRY BATTERY (better than ever).

Prices to suit buyers who are using cheaper grades.

MANHATTAN ELECTRICAL SUPPLY CO.,

32 CORTLANDT STREET, NEW YORK.



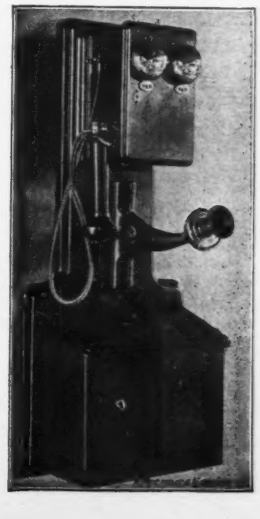
"IMPERIAL"

IMPERIAL TELEPHONES and SWITCHBOARDS are PERFECT in IMPERIAL ELECTRICAL and MECHANICAL EFFICIENCY. THE HIGHEST GRADE INSTRUMENT ON THE MARKET

If you are not using the "IMPERIAL" 'Phones you are making a great mistake. We guarantee BETTER CONSTRUCTION AND BETTER SERVICE at LESS COST of MAINTENANCE than can be secured with any other instrument. Our SWITCHBOARDS embody many new ideas and their service is always satisfactory. SIMPLEST and BEST CONSTRUCTED. DROPS and JACKS SELF-CONTAINED, and LINE and RING-OFF DROP-SHUTTERS SELF-RESTORED.

A trial is all we ask to convince you of the absolute superiority of our apparatus.

WRITE US FOR FURTHER DESCRIPTION AND PRICES.



THE TELEPHONE MFG. COMPANY, SUMTER, S. C.

HIGH-GRADE NON-INFRINGING APPARATUS.

LARGEST MANUFACTURERS OF TELEPHONES AND ACCESSORIES IN THE U. S.

Our new Express System is adapted for use in both large and small exchanges; our Express switchboard is a new departure and possesses original features, being the most rapid switching apparatus ever devised.

SELF-RESTORING DROP.
SELF-RESTORING RING-OFF.
RAPID RINGING DEVICE.

Drops mounted in non-inductive metal shell, combined drop and jack in self-contained hard-rubber case, can be removed and replaced in board in one minute without disturbing connections. Each drop indicates as to whether line is working properly.

WILL PAY A DAILY DIVIDEND IN QUALITY OF SERVICE RENDERED.

OUR AMERICAN SOLID BACK AMPLIFYING TRANSMITTER

is the most powerful instrument yet produced. Especially built for Long and Severe Lines, and for volume of voice transmission, distinctness of articulation, exact reproduction of voice and durable qualities is unequaled.

Manufacturers of full line of devices of high efficiency adapted to meet special requirements of service, including the best Bridging Instruments and Repeating Coils on the market.

OVER 500 FLOURISHING EXCHANGES EQUIPPED.
PROTECTION GUARANTEED TO PATRONS.
EXPERT ADVICE FURNISHED.

Correspondence solicited. Address

AMERICAN ELECTRIC TELEPHONE CO.

Nos. 171-173 So. Canal Street, Chicago.

SEE OUR EXHIBIT, INTERNATIONAL EXPOSITION, OMAHA, 1898.
SEE OUR EXHIBIT, PARIS EXPOSITION, 1900.
MEDAL AWARDED, COTTON STATES EXPOSITION, ATLANTA, GA., 1895.
MEDAL AWARDED, TENNESSEE CENTENNIAL, NASHVILLE, TENN., 1897.

High-Grade Magneto Bell, No. 1.

WHOLESALE.

High-Grade Magneto Bell, No. 3.

MAGNETO BELLS AND TELEPHONES FOR EXCHANGES, TOLL LINES AND PRIVATE LINES.

SEND FOR CATALOGUE.

FARR TELEPHONE AND CONSTRUCTION SUPPLY CO.,
357 DEARBORN ST., CHICAGO.

A Physician said:

"I would as soon think of taking off the door-bell as of doing without the telephone service."

Message Rates
make the cost of telephone service in New York very moderate.

Standard Equipment
for all subscribers. The rate varies with the amount of use.

NEW YORK TELEPHONE CO.
15 Dey St., 962 Broadway, 115 W. 38th St.

ELECTRIC CONDENSERS.

WM. MARSHALL, Manufacturer.

STANDARDS A SPECIALTY

709 Lexington Avenue, New York.

DIVIDED CIRCUIT TOLL LINE SYSTEM

far better than the bridging or series.

Absolutely free from the patent claims of others, including the broad claims of the Carbe patent for bridging telephone system recently upheld as valid in Pennsylvania.

DON'T BUY A LAWSUIT, BUY S-C APPARATUS.

All goods fully patented. Non-infringing.

GUARANTEED INDEFINITE.

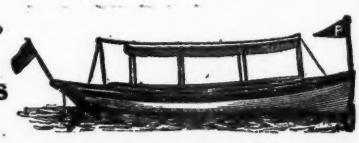
The only manufacturers selling a full line of Public Exchange, Toll Line, Police, Fire-Alarm, Street Railway and Private Plant Telephone Equipment, fully protected by patent. We respect all patent claims of others.

— THE —

STROMBERG-CARLSON TELEPHONE MFG. CO.

72-82 W. JACKSON BOULEVARD, CHICAGO, ILL.

PALMER
STATIONARY AND MARINE
GASOLINE ENGINES
AND
LAUNCHES.
SEND FOR CATALOGUE.

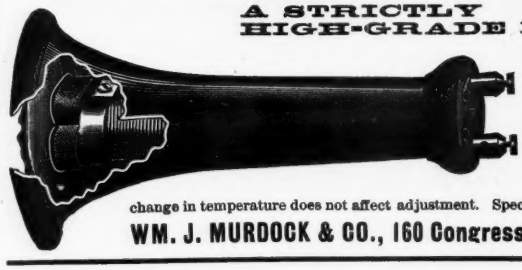


Motor Wagons, Engines, Engine Castings, Pumping Engines.

PALMER BROS.
Mianus, Conn.

THE M RECEIVER.

A STRICTLY HIGH-GRADE RECEIVER



PONY TYPE.
DOUBLE-POLE.
HARD-RUBBER CASE.
PLATE BINDING-POSTS.
BEST STEEL MAGNETS.
WEIGHT, 12 OZ.

Magnet is supported near the diaphragm so that the change in temperature does not affect adjustment. Special price in quantities.

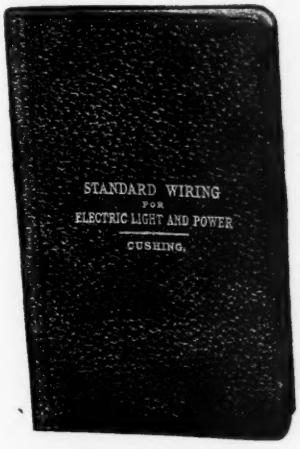
WM. J. MURDOCK & CO., 160 Congress St., Boston, Mass.

CATALOGUES COME QUICKLY when you mention the ELECTRICAL REVIEW to the advertiser.

THE AMERICAN BELL TELEPHONE COMPANY,

125 MILK STREET, BOSTON, MASS.

This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.



THE RECOGNIZED AUTHORITY ON WIRING AND CONSTRUCTION.

The Universally Adopted National Electrical Code explained and illustrated in this year's edition of the Handbook.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, JR., A. I. E. E., Electrical Engineer and Inspector.

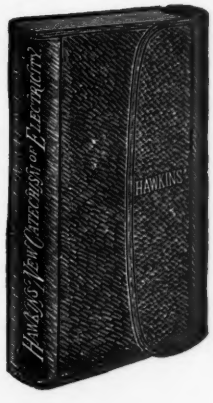
ADOPTED { by The Fire Underwriters of the United States.
by Cornell University, Stanford University and Other Technical Colleges and Schools.
by 20,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE { it is the only book on Wiring and Construction kept strictly up to date.
it contains all the necessary Tables, Rules, Formulas and Illustrations
it settles disputes, and if referred to before wiring will prevent disputes.

FLEXIBLE LEATHER COVER (Pocket Size), $1.00. Sent postpaid, upon receipt of price, by

ELECTRICAL REVIEW, 41 Park Row, New York City.

HAWKINS' NEW CATECHISM OF ELECTRICITY



A PRACTICAL TREATISE.

A book of 550 pages, full of up-to-date information, 300 illustrations, handsomely bound in fine red leather, pocket-book form, with titles and edges in gold.

PRICE, $2.00

SENT, POSTAGE FREE, ON RECEIPT OF PRICE BY

ELECTRICAL REVIEW PUB. CO.,

TIMES BUILDING, NEW YORK CITY.

OKONITE
TRADE MARK.

1889
PARIS EXPOSITION MEDAL
FOR RUBBER INSULATION.

1898
WORLD'S FAIR MEDAL
FOR RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

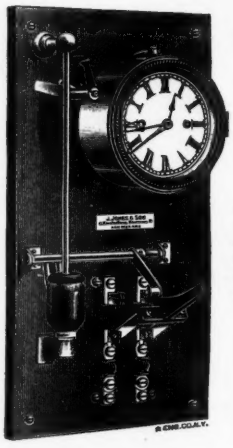
— SOLE MANUFACTURERS OF —

OKONITE WIRES, OKONITE TAPE, MANSON TAPE,
CANDEE WEATHERPROOF WIRES.

THE OKONITE CO., Ltd.,

WILLARD L. CANDEE, } Managers.
S. DURANT CHEEVER, }
GEO. T. MANSON, General Supt.
W. B. HODGINS, Secretary.

253 Broadway, N. Y.



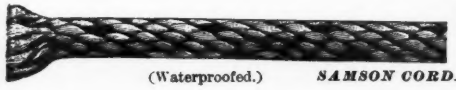
AUTOMATIC TIME CUTOUT.

Electric Light Companies should push these into use for the reason that when a customer has a sign, show-window lights, or any use for lights in any place, he will keep on current longer, for the good reason that he can have it cut off at any hour he designates; whereas, if he has an ordinary switch the current is turned off early in the evening.

List, $15.00. Discount to the trade.

J. JONES & SON,
GENERAL ELECTRIC SUPPLIES,
168 CORTLANDT ST., - - NEW YORK.
FACTORY, BROOKLYN.

ROEBLING RUBBER WIRE



SAMSON SPOT CORD
For ARC LIGHT and TROLLEY CORD.
Send for Samples and Prices.
(Waterproofed.) SAMSON CORDAGE WORKS, BOSTON, MASS.

No. 2156.

The Great Church Light

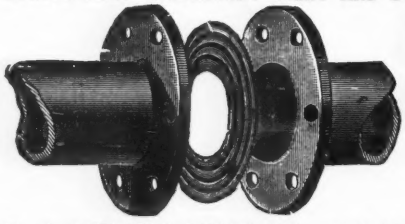
FRINK'S PATENT REFLECTORS AND REFLECTING CHANDELIERS have lighted over 20,000 churches alone.

SPECIFIED by leading architects and engineers, and everywhere used for lighting churches, halls, theaters, art galleries, stores, store windows, banks, schools, hospitals, office and public buildings, etc.

BOOK OF LIGHT AND ESTIMATE FREE.

I. P. FRINK,
GEORGE FRINK SPENCER, MANAGER.
551 Pearl Street, NEW YORK.

JOINTS MADE ABSOLUTELY TIGHT AND DURABLE BY PATENT CORRUGATED



COPPER GASKETS.

Furnished in all shapes and sizes for Flanged Pipes, Cylinders, Chests, etc.

PRICE LIST AND SAMPLE FREE.

U. S. MINERAL WOOL CO., 174 Washington St., NEW YORK.

BOURNE & KNOWLES MFG. CO., Cleveland, Ohio.

DO YOU KNOW

That your ELECTRIC Light can be REGULATED as easily and economically as GAS?
Send us your order for regulating Sockets.

McCAY ENGINEERING CO.,

No. 108 E. German St., BALTIMORE, MD.

State base, voltage and ALTERNATIONS.

THE BABCOCK & WILCOX CO.

29 CORTLAND ST. NEW YORK
CABLE ADDRESS NEW YORK "GLOVEBOXES"
ALL FOREIGN OFFICES "BABCOCK"

STEAM

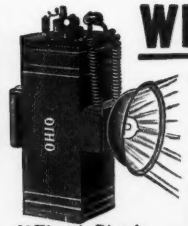
WATER TUBE BOILERS

SEND FOR OUR BOOK "STEAM"

BRANCH OFFICES
BOSTON 8 OLIVER ST.
PHILADELPHIA 642 DREXEL BLDG.
SAN FRANCISCO 32 FIRST ST.
CHICAGO 1115 MARQUETTE BLDG.
NEW ORLEANS 339 CARONDELET ST.
PITTSBURGH 1004 CARNEGIE BLDG.
ATLANTA, GA. 819 EQUITABLE BLDG.
CLEVELAND 413 CUYAHOGA BLDG.
ST. LOUIS MO. 817 SECURITY BLDG.
HAVANA, CUBA 31 CALLE DE LA AMARGURA.

Necktie Light.

$1.00 Motor.



$6 Electric Bicycle Lights, $2.75

WE ARE SELLING

$ 3.00 Electric Bell Outfits for	$ 1.00
21.00 Telephones, complete, for	5.95
12.00 Fan Motors, with Batteries, for	5.95
8.00 Electric Hand Lanterns for	3.00
10.00 Electric Carriage Lights for	3.95
8.00 Medical Batteries for	3.95
5.00 Electric Belts, the genuine, for	1.00
3.00 Necktie Lights	1.50
14-Candle Hanging Lamp, with Battery.	10.00
Telegraph Outfits, complete, for	2.25
Miniature Electric Lamps for	.40
Sewing Machine Motors for	5.00

All Electrical Books at low prices.

We undersell all on Everything Electrical.

OHIO ELECTRIC WORKS, CLEVELAND, O.
HEADQUARTERS FOR ELECTRIC NOVELTIES AND SUPPLIES.
Agents wanted. Send for New Catalogue just out.

REPORT OF ELECTRIC VEHICLE NAME COMMITTEE.
ELECTRICAL EXHIBITION, NEW YORK, MAY 8-JUNE 3.--No. 6.

ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. XXXIV.—No. 23. NEW YORK, WEDNESDAY, JUNE 7, 1899. TEN CENTS A COPY. THREE DOLLARS A YEAR.
Copyright, 1899, by ELECTRICAL REVIEW PUB. CO.

THE
PHOENIX GLASS CO.
MANUFACTURERS OF
GAS AND ELECTRIC
GLOBES, SHADES, Etc.
HAVE YOU A COPY OF OUR No. 8 CATALOGUE? IF NOT, SEND FOR IT.
Pittsburgh. New York. Chicago.

ALL VOLTAGES

ANY CANDLE-POWER

SEND FOR OUR
Artistic Fan Motor Catalog
ELECTRIC APPLIANCE COMPANY,
92 & 94 WEST VAN BUREN ST., CHICAGO.
America's Largest Electrical Supply House

N. I. R.
WIRES and CABLES.
NATIONAL INDIA RUBBER CO.
FACTORY AND GENERAL OFFICES, BRISTOL, R. I.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Mgrs.
GEO. T. MANSON, Gen. Supt. W. H. HODGINS, Secy.
1889 PARIS EXPOSITION MEDAL FOR RUBBER INSULATION
OKONITE
TRADE MARK
1893 WORLD'S FAIR MEDAL FOR RUBBER INSULATION
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES. Write for Prices.
THE OKONITE CO., Ltd., 253 Broadway, New York.

DROP FORGED COMMUTATOR BARS.
"TRUE TO GAUGE."
The Billings & Spencer Co.,
HARTFORD, CT.

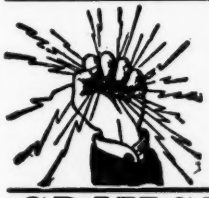
THE BRISTOL COMPANY
WATERBURY, CONN.

RECORDING VOLTMETERS,
RECORDING AMPEREMETERS,
RECORDING WATTMETERS,
RECORDING PRESSURE GAUGES,
RECORDING THERMOMETERS,
PAY FOR THEMSELVES.
SEND FOR CATALOGUE.

NATIONAL CONDUIT & CABLE COMPANY,
Manufacturers and Patentees of
PAPER INSULATED CABLES and WROUGHT-IRON CEMENT-LINED PIPES for UNDERGROUND SUBWAYS.
73,000,000 Feet of Our Conduit and Thousands of Miles of Our Cables in Use in United States, Canada and the British Isles.
MAIN OFFICE: TIMES BUILDING, NEW YORK.
Branches: Rookery, Chicago, Ill. Ames B'ld'g, Boston, Mass.

INDIA AND AMBER MICA
In any shape or pattern
EUGENE MUNSELL & CO.,
218 Water Street, NEW YORK.
117 Lake Street, CHICAGO.
Write for Samples & Prices

CROCKER-WHEELER CO.
Main Office: 39 Cortlandt Street, New York.
Direct-Current Dynamos, Motors and Dynamotors.
Works: Ampere, N. J.


AMERICAN ELECTRICAL WORKS
PROVIDENCE, R. I.
Bare and Insulated Electric Wire.

MATCHLESS ELECTRIC LIGHTER! MAKE MONEY QUICK.
AGENTS WANTED. Electric Light or Battery Current.
Endorsed by Fire Underwriters. A practical Electrical Novelty.
Sells at Sight. SPECIAL PRICES TO THE SUPPLY TRADE.
Send for Descriptive Circular.
STANLEY & PATTERSON, General Electrical Equipment Supplies, 32-34 Frankfort St., New York.

GRIMSHAW WHITE CORE WIRES,
RAVEN WHITE CORE WIRES,
RAVEN BLACK CORE WIRES,
COMPETITION LINE WIRES,
GRIMSHAW and COMPETITION TAPES and SPLICING COMPOUNDS.
BRANCHES:
CHICAGO, 320 Dearborn Street.
BOSTON, 134 Congress Street.
SAN FRANCISCO, 71 Flood Building.
Manufactured by NEW YORK INSULATED WIRE COMPANY,
Main Office, 13-15-17 Cortlandt Street, New York.

KOCH Dynamo Brush
GOLDMARK & WALLACE,
Agents for U. S. 123 Worth St., New York.

MONTAUK MULTIPHASE CABLE CO.
ONLY FIRE DETECTIVE CABLE IN THE WORLD.
See Description on inside page.
100 BROADWAY, NEW YORK CITY.

CREFELD ELECTRICAL WORKS
WIRES AND CABLES,
49 Federal Street, BOSTON.

American Vitrified Conduit Co.
VITRIFIED GLAZED CONDUITS.
UNDERGROUND CONDUIT SYSTEMS.
General Office, 39-41 Cortlandt St., NEW YORK.
C. J. Field, Gen. Man. and Chief Engineer.

WARREN ELECTRIC & SPECIALTY CO.,
WARREN, OHIO, U. S. A.
Manufacturers
"PEERLESS"
INCANDESCENT LAMPS, FAN MOTORS, TRANSFORMERS.

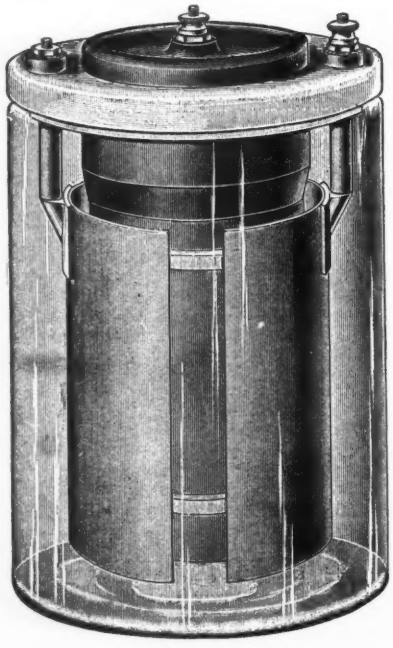
Our NEW IMPROVED BATTERY keeps the
American Electric Vehicle Co.
IN THE LEAD — PIONEERS ALWAYS
Send for Catalogue of Carriages
1545 Michigan Avenue Chicago, U. S. A.

SIMPLEX WIRES AND CABLES
FOR UNDERGROUND, SUBMARINE, LINE AND INSIDE CONSTRUCTION
SIMPLEX ELECTRICAL CO
75 BICKNHILL BOSTON 1211 MONADNOCK BLOCK CHICAGO

PHŒNIX BATTERY MANUFACTURING CO. ST. LOUIS.

1st. Our ***PHŒNIX*** No. 1 Battery—protected by letters patent, 500,284. The best cell that can be made. Low prices to the trade in round lots.

2d. Our ***PROGRESS*** Dry Battery—***Principle new.*** A trial order will convince the trade that the ***Progress*** is the ***best Dry Battery*** that can be made, and the only Dry Battery ever constructed that can be renewed at a ***nominal cost.***



3d. Our ***PERFECTION*** Battery, or Electric Generator, for closed or open-circuit work—Fan motors, signal service and long-distance telephone.

The longest life and the least cost for renewals of any Battery in the market to-day.

This Battery will give three-hundred ampere-hours—E. M. F., 2 volts; current 12 amperes—and can be renewed at a cost of 25 cents per cell.

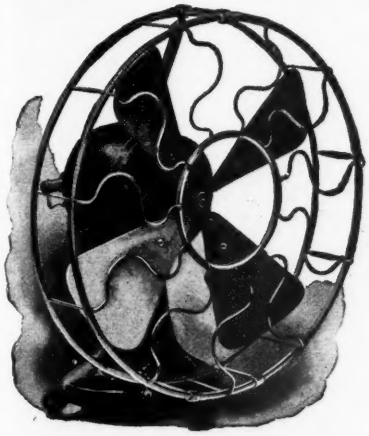
We are determined to stand at the head in Battery manufactures.
Our products are the result of invention, application and construction, and we will prosecute, to the utmost, all infringers and imitators.
Will take pleasure in giving information, or in sending samples to the *Trade.*

Phœnix Battery Mfg. Co.,

S. G. BOOKER, Supt.

St. Louis, Mo.

THE DAYS WHEN ELECTRIC FAN



apparatus is appreciated to the fullest extent are now upon us, and we have aimed to make our establishment the most attractive spot in Greater New York for all varieties.

If you do not live in our town, and want an immediate shipment, we can send you a catalogue, quote lowest prices, and get them to you quickly.

The illustration shows one type of the splendid

Lundell Fan

and we have all the other makes of LUNDELL'S in stock.

Fan for Direct, Alternating and Battery Currents

J. JONES & SON, ELECTRICAL SUPPLY HOUSE 66 Cortlandt St., New York

Central Soldering Compound

is a form of flux that is absolutely non-corrosive and is most valuable in soldering ***Fixture Work*** and all ***Electrical Wiring*** and thoroughly well adapted for ***Annunciators, Telephones, Switchboards, etc.*** It is readily applied and will induce a firm and lasting connection by reason of entering all minute spaces and inducing the solder to follow.

Soldering with the Central Soldering Compound will be found free from caustic after-effects and the residue does not absorb moisture, hence all joint insulation is reliable.

The collapsible tin tube is 4¾ inches high by 2¾ inches in circumference.

Price per Tube, 25 Cents.

Liberal Discount per Quantity Order.

Central Electric Company,

264-266-268-270 Fifth Avenue, Chicago.

SOUTHERN ELECTRIC SUPPLY CO., St. Louis.

OKONITE IT NEVER DISAPPOINTS

H. N. FENNER, President. J. F. BLAUVELT, Agent. RUSSELL W. KNIGHT, Treasurer.

NEW ENGLAND BUTT COMPANY,

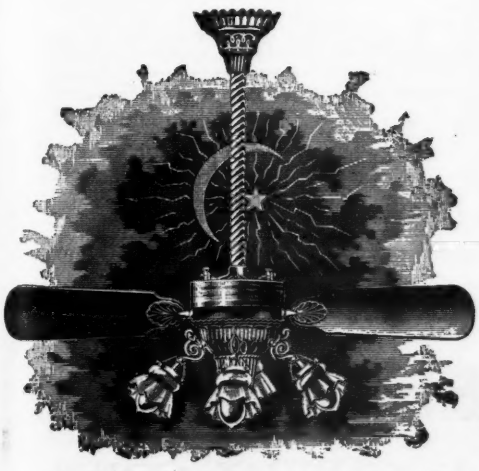
MANUFACTURERS OF

MACHINERY FOR INSULATING ELECTRICAL WIRES.

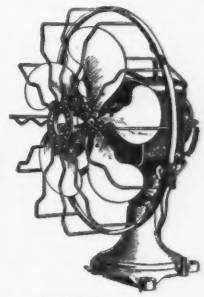
Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders.

FINE CASTINGS A SPECIALTY.

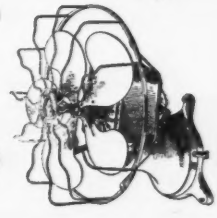
304 PEARL STREET, - - - - PROVIDENCE, R. I., U. S. A.



The NEW Crescent Fans.



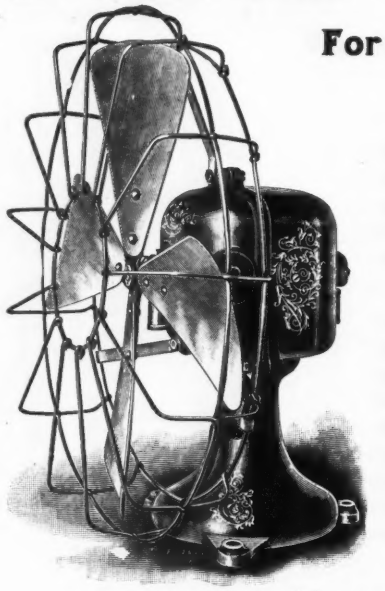
These Fans ARE POSITIVELY without the humming noise so frequent with other Fans. We will place these in competition with any others manufactured. OBSERVE NEW BLADES, swivel joint furnished with each Address,



Marietta Manufacturing Co.,

MARIETTA, PA.

DIEHL ELECTRIC FANS



For all Circuits, except Alternating.

Our line of electric fans for ALL purposes for the present season is the most complete that we have ever placed on the market, and the high standard of our product has been strictly upheld.

Our fans are the cheapest because they are absolutely the best made; wear longest, require less outlay for repairs and show a higher efficiency than any other fan. This statement is fully sustained by the past record of our fans. Our place has always been in the lead and we intend to maintain that position.

SEND FOR CATALOGUE.

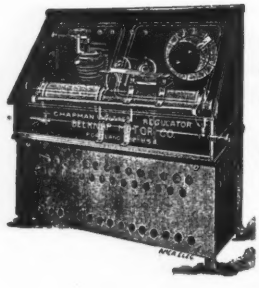
DIEHL MANUFACTURING COMPANY,

SHOW-ROOMS: 561-563 Broadway, NEW YORK. 192-194 Van Buren St., CHICAGO. 128-132 Essex St., BOSTON.

Main Office and Works, ELIZABETHPORT, N. J.

CHAPMAN VOLTAGE REGULATORS

For ALTERNATING or DIRECT CURRENT SYSTEMS.



Insure *STEADY LIGHTS* in spite of *CHANGING SPEED* and *VARYING LOADS.* They *COMPENSATE* for *LINE LOSS* and automatically keep a constant Voltage at any chosen center of distribution, however distant. Write for particulars.

We also manufacture Water Motors, Electric Motors and Dynamos in the Bipolar and Multipolar types. Copper Mills with water and electric attachments.

REGULATORS SENT ON 30 DAYS' TRIAL.

SOLE MANUFACTURERS, **BELKNAP MOTOR COMPANY,**

PORTLAND, - - - MAINE.

Branches: Boston, New York, Philadelphia, Chicago, St. Louis, Milwaukee, Toledo, Denver, San Francisco.

FANS! FANS!! FANS!!!

We handle a COMPLETE line of DESK and CEILING FANS. As hot weather is now approaching, and money is PLENTIFUL, every one should have one. Be comfortable.

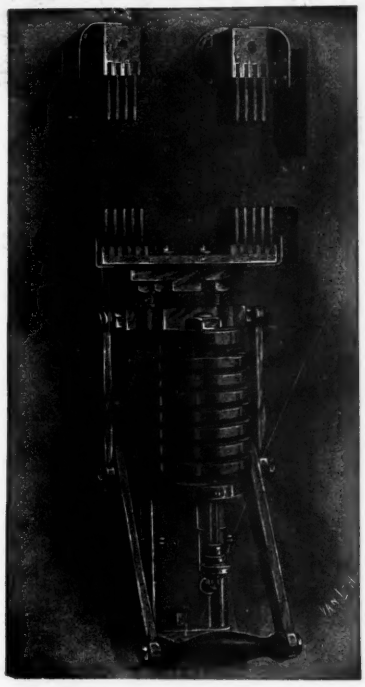
REASONABLE IN PRICE.

THE NEW ENGLAND ENGINEERING CO.

ENGINEERS AND CONTRACTORS,

WRITE US. WATERBURY, CONN.

Automatic Circuit-Breakers



Our

Circuit-Breakers do not swing

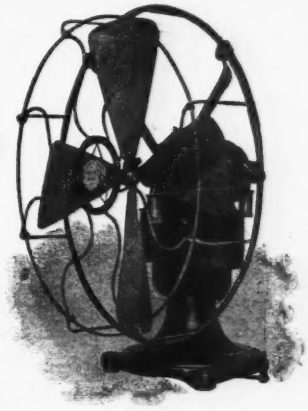
out from the board—
They are well made and finished.

Fisher Electrical Manufacturing Co.

DETROIT, MICH.

A 40-PAGE FAN Motor Catalogue mailed to any address upon request.

DESK FANS



For Direct Current.

12-inch and 16-inch Fans.

Made for Nos. 110, 220 and 550 Volts. THREE SPEEDS.
Bulletin 17 F gives full description of DESK FAN MOTORS.

Makers of
CEILING, COLUMN, BRACKET and DESK FAN MOTORS.

Western Electric Company,
CHICAGO. NEW YORK.

Manufacturers and Dealers Electric Light and Power Apparatus, Arc and Incandescent Lamps, Wire, Cable, Telegraph Station and Measuring Instruments, Electric Light and General Supplies.

London, 79 Coleman Street, E. C., and North Woolrich, E.
Antwerp, 33 Rue Boudewyns.
Paris, 45 Avenue de Breteuil.

"STERLING" STANDARD SUPPLIES } FOR..... STREET..... RAILWAYS

ARE THE ASSEMBLING OF

EXPERIENCE, BEST MATERIAL, SUPERIOR WORKMANSHIP.

THE RESULT:

HIGHEST QUALITY GOODS.

FARE REGISTERS, FENDERS.

SAFETY BRAKES,

SAND BOXES.

INSULATION, COMMUTATORS.

Sterling Supply & Mfg. Co.,
141-155 East 25th Street, NEW YORK CITY.

Prompt shipments of alternating-current desk and bracket fans.

THE
Emerson Electric Mfg. Co.,
St. Louis, Mo.

Steel Outlet and Junction Boxes,
SWITCHBOARDS, PANEL BOARDS, SWITCHES, ETC.
MADE BY
THE BOSSERT ELECTRIC CONSTRUCTION CO.
UTICA, N. Y.

TWO THOUSAND
Dynamos and Motors .....in Constant Operation

The HOBART Multipolar and Bipolar Dynamos and Motors are noted for their

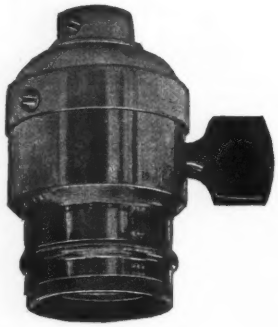
Simplicity, Durability, Efficiency

HIGHEST QUALITY AT MOST REASONABLE PRICES
General Electrical Appliances

WRITE FOR PRICES CORRESPONDENCE SOLICITED

Hobart Electric Mfg. Co., Troy, Ohio

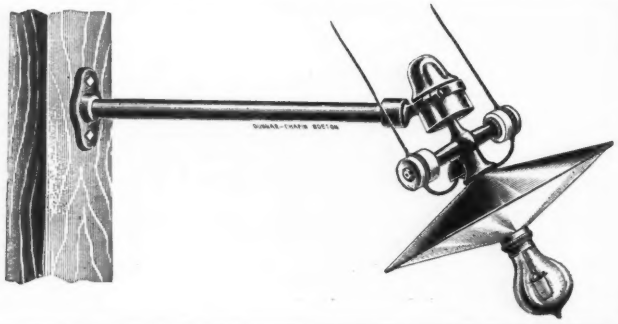
The General Electric Company's EDISON SOCKETS



with characteristic screw base, embody in their design and manufacture all the elements of simplicity, durability and reliability.

The General Electric Plug and Link Cutouts, Ceiling Rosettes, Punched Clip Knife Switches, Porcelain Cleats, and Porcelain Knobs are absolutely uniform in quality and stand the severest tests.

GENERAL ELECTRIC COMPANY.
Main Office: SCHENECTADY, N. Y.
Sales Offices in all large cities.



HIGH-TENSION STREET FIXTURES.

OUR NEW HIGH TENSION-STREET FIXTURE is as perfectly insulated as any part of a circuit, the head being separated from the supporting arm by a double petticoat glass insulator.

NO DANGER of wire being grounded through imperfect insulation as is the case when a fixture depends entirely on a light covering of the wire.

Write us for further description. Manufactured only by

F. W. MESERVE,
Electric Construction and Supplies, South Framingham, Mass.

Fan-Motor Outfits AND Gordon Primary Cells....

To secure comfort at home, relief in sick-room and sleeping-place, as well as in professional office and place of business during the hot weather, we recommend as indispensable the **KNAPP FAN MOTORS,** in connection with the Gordon Primary Cells.

These outfits are placed upon the market in two sizes:

Type C, 8-inch Fan, with three No. 1A Gordon Cells, . $17.50
Type D, 10-inch Fan, with four No. 1A Gordon Cells, . 25.00
Recharges for Type C Outfit 3.60
Recharges for Type D Outfit, ... 4.80

Each outfit will give over 150 running hours per charge, *without* attention.

For full particulars and descriptive Circular, apply to

GORDON BATTERY CO., 594 Broadway, New York.

Columbia Automobiles.....

AT THE

ELECTRICAL EXHIBITION, MADISON SQUARE GARDEN,

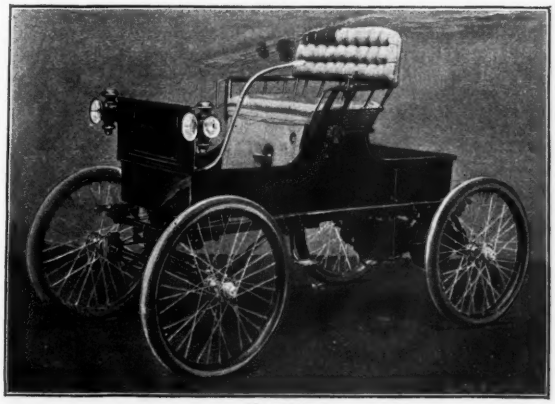
May 18th to June 3d.

Electric Runabouts,
Electric Phaetons,
Electric Dos-a-dos,
Electric Surreys,
Electric Victorias,
Electric Broughams,

Electric Carriages for Physicians, both closed and open.
Electric Delivery Wagons,
Electric Emergency and Repair Wagons for Central Station and Street Railway Service.

COLUMBIA AUTOMOBILE COMPANY,

NEW YORK OFFICE, Broadway and Sixtieth Street. HARTFORD, CONN.



No. ½ A.

THE WOOD ELECTRIC

MOTO-VEHICLES.

SEND FOR "SPECIALLY FINE" CATALOGUE.

AMONG OTHER THINGS WE GUARANTEE ARE:

That the material and workmanship in the vehicle shall be of the very best, including rubber tires and ball-bearing axles.
That for a period of one year the Company will replace, free of charge, any broken parts due to defective material or faulty shop construction.
That the vehicle shall have, on a level hard roadway, a mileage capacity in one charge of the batteries that will carry its given load twenty-five miles at an average speed of twelve and one-half miles per hour, two hours.
That the batteries can be charged when fully discharged in two and one half hours' time.
That the vehicle shall be capable of climbing a six per cent grade with given load when batteries are reasonably well charged.
That for the sum of $50.00 per annum, the Company will furnish all parts for keeping batteries in perfect repairs for a period of five (5) years, leaving them at the end of the five years in good condition for operation during the ensuing year

AVERAGE COST TO RUN PER MILE, 3-4 CENT.

FISCHER EQUIPMENT CO.,
110-112 East Twentieth St., CHICAGO, ILL., U. S. A.

ESTABLISHED 1878.

J. H. BUNNELL & CO.,

76 CORTLANDT STREET, Corner Washington Street, NEW YORK.

WE ARE HERE TO FILL ORDERS FOR EVERYTHING ELECTRICAL AT RIGHT PRICES. . . . . .

Prompt Attention Given to All Inquiries and Orders. We shall continue to deserve the Honored Distinction of being the Makers of the BEST TELEGRAPH INSTRUMENTS ON EARTH!!

They are the Acknowledged Standard of the World. We have just issued a new TELEPHONE CATALOGUE AND MANUAL OF TELEGRAPHY. Send for a copy, and mention this paper.

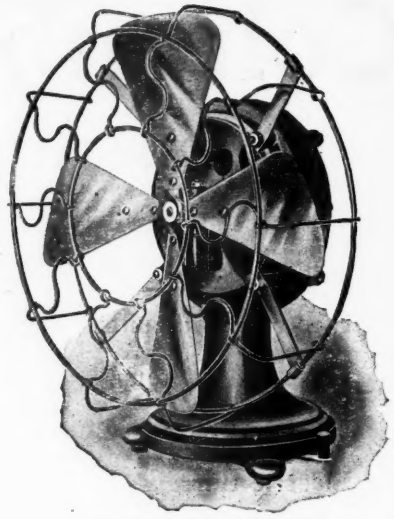
J. H. BUNNELL & CO., 76 CORTLANDT STREET, Cor. Washington Street, NEW YORK.

The best evidence of **Lundell** popularity and quality is the number sold. Mere cheapness may seem, at times, to have the advantage, but *quality* has it *all* the time and holds its own against all competition.

We have a letter, from a dealer in a southern town, enclosing a list showing the sale of several hundred fan motors of all kinds. In his own words "he sells what the people want." **Over 55 per cent of the people wanted Lundell Fans.** In his account of *repair* work every make was represented **except Lundells.**

Brush Holders for Lundell Direct-Current Fans.

While competitors are seeking cheapness the makers of the Lundell are seeking improvement and quality.



Lundell Alternating Fan.
Made in Desk and Bracket Styles.

Catalogue 663.

SPRAGUE ELECTRIC COMPANY,
20 BROAD STREET, NEW YORK.

THE DAYS OF TIGHT BELTS ARE OVER.

A Slack Belt with
CLING-SURFACE on it,
and a Tight Belt without it.

See our Exhibit at the Electrical Exhibition, Madison Square Garden, New York.

CLING-SURFACE MFG. CO. 178-184 Virginia St., Buffalo, N. Y.

THE STANDARD FANS.

CEILING FANS in two styles, **A** and **B**.

Two or four blades.

For all direct-current circuits. To be operated either singly or in series.

All finishes are superb.

Style A, with Two-speed Switch.

DESK AND BRACKET FANS, with 12′ or 16′ blades.

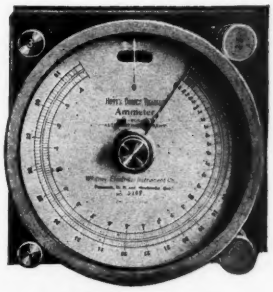
Two speeds.

Finished in superb black enamel, with heavily nickeled trimmings, blades and guard.

The STANDARD are the Fans that BLOW, and consume less current than any of them. Entire satisfaction in any requirement guaranteed.

THE ROBBINS & MYERS CO.,

SPRINGFIELD, OHIO, U. S. A.



THE SELF-CALIBRATING

feature of our dynamometer type of instruments is worth investigating.

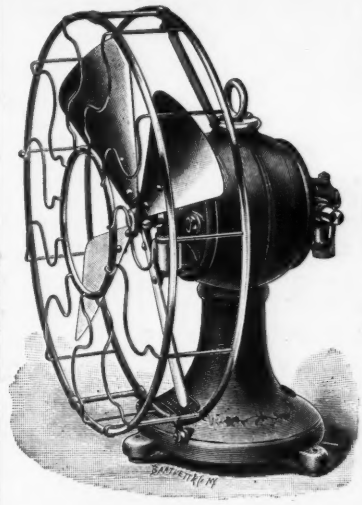
WHITNEY ELECTRICAL INSTRUMENT CO.

Manufacturers of a complete line of electrical instruments of precision.

Volt, Ampere, Ohm and Wattmeters for Direct and Alternating Current.

MACHADO & ROLLER,

General Selling Office: 203 Broadway, N. Y. City.



LUNDELL

FAN MOTORS

For 1899.

ILLINOIS ELECTRIC COMPANY,

Exclusive CHICAGO AGENTS,

239 Madison St., CHICAGO.

TRY OUR COLUMBIA CARBONS FOR DIRECT-CURRENT ARCS.

They are a few points ahead of any of the imported bra[illegible]

Samples free to any one interested.

NATIONAL CARBON COMPANY,

965 Highland Ave., Cleveland, Ohio.

IT'S CLEARLY A MATTER OF DOLLARS AND CENTS.

CENTRAL station and railway managers, and in fact all users of steam who knowingly allow this golden opportunity to pass by without taking cognizance of the fact, must surely be ignorant of the fundamental laws of economy, for, to use the words of a great man:

"Little wastes in great establishments, constantly occurring, may defeat the energies of a mighty capital."

Your waste steam amounts to about 85 per cent out of a possible 100 per cent. The remaining 15 per cent you make good use of. Why not utilize it all?

It can be done and is being done in a great many communities with success.

STEAM is the only reliable heating medium for conveyance long distances. **ELECTRICITY** is too expensive for house heating. **WATER** is too sluggish in movement, and consequently too expensive in delivery. Besides, hot water pipes are known to be short lived, and mains must be replaced **EVERY THREE TO SIX YEARS.** Every 100 horse-power of your exhaust steam will heat one million cubic feet of space, and sells for $2,500 to $3,500.

The coal pile is too important a factor in the successful operation of electric light, power and traction plants to be ignored, and every ounce of the "black diamond" should be made to do its duty, otherwise there will be a perceptible loss.

No one realizes this better than yourselves. **YOU** know what your trouble is and **WE** supply the remedy. Summed up it is this:

Utilize your 85 per cent exhaust steam by piping it under ground by the HOLLY SYSTEM of steam distribution (direct and exhaust) for heating stores, churches, dwellings, theaters, etc. We would be pleased to have you inquire further into this matter and will gladly give you information.

SEND FOR OUR CATALOGUE TREATING MORE FULLY ON THIS SUBJECT.

AMERICAN DISTRICT STEAM CO., - - - LOCKPORT, N. Y.

VOLTMETERS and AMMETERS.

Handsomely finished and of highest grade.

ALSO

Switchboard Instruments.

Send for information and prices.

MANUFACTURED BY

NORTON ELECTRICAL INSTRUMENT CO.
Manchester, Conn., U. S. A.

KOHLER BROTHERS, Western Agents,
No. 1648 Monadnock Block, Chicago, Ill.

Porcelain Manufactory.

EMPIRE CHINA WORKS,

144-156 Greene Street, Station C,

BROOKLYN, N. Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS, Etc.

THE

G. & E. BORING MACHINE

For Electrical Wiring.

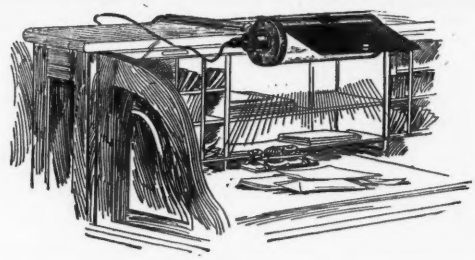
A GREAT LABOR SAVER.

Saves at least 50 per cent labor in boring holes; wires can be pulled through many holes; it saves wire; it saves the insulation. You need no stepladder for boring holes. If you want to control the wiring in your town, write for prices, etc., to the

G. & E. ELECTRIC CO.,

BINGHAMTON, N. Y.

THE KINSMAN DESK LAMP



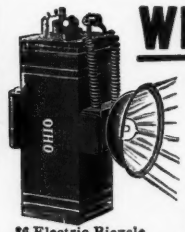
is the only electric fixture made which will properly light a roll-top desk and at the same time shield the eyes. Send for pocket catalogue. Beware of spurious imitations.

McLEOD, WARD & CO.,

27 THAMES STREET, NEW YORK.

Necktie Light.

$1.00 Motor.



$6 Electric Bicycle Lights, $2.75

WE ARE SELLING

$ 8.00 Electric Bell Outfits for	$ 1.00
21.00 Telephones, complete, for	5.95
12.00 Fan Motors, with Batteries, for	5.95
8.00 Electric Hand Lanterns for	3.00
10.00 Electric Carriage Lights for	3.95
8.00 Medical Batteries for	3.95
5.00 Electric Belts, the genuine, for	1 00
3.00 Necktie Lights	1.50
14-Candle Hanging Lamp, with Battery.	10 00
Telegraph Outfits, complete, for	2.25
Miniature Electric Lamps for	.40
Sewing Machine Motors for	6.00

All Electrical Books at low prices.

We undersell all on Everything Electrical.

OHIO ELECTRIC WORKS, CLEVELAND, O.

HEADQUARTERS FOR ELECTRIC NOVELTIES AND SUPPLIES.

Agents wanted. Send for New Catalogue just out.

ASTORIA. ✳ DELMONICO'S. ✳ SHERRY'S.

HABIRSHAW

WIRES & CABLES

USED THROUGHOUT THIS BUILDING.

The India Rubber and Gutta Percha Insulating Co.

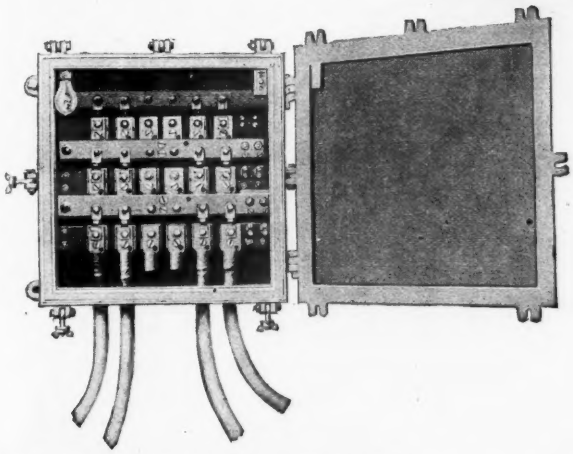
Main Office, Glenwood Works,

YONKERS, N. Y.

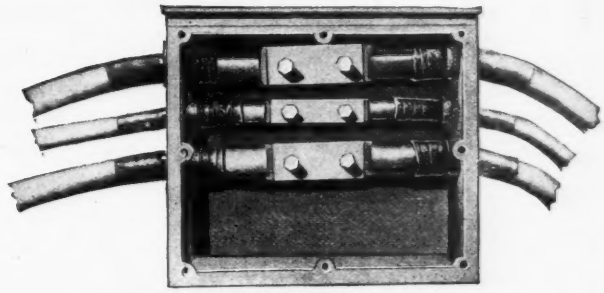
J. W. GODFREY, Manager Sales,
15 Cortlandt Street, New York.

G. I.

Underground Material



Tailleur Service Boxes.
Tailleur High-Tension Coupling Joints.



Tailleur Coupling Boxes.
Tailleur Junction Boxes.

GENERAL INCANDESCENT ARC LIGHT COMPANY,

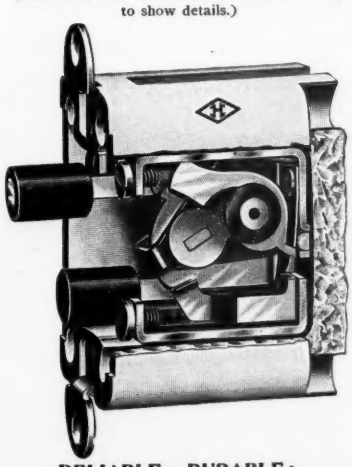
572-578 FIRST AVENUE, NEW YORK.

NEW YORK: 39-41 Cortlandt Street. BOSTON: 31 Milk Street. PHILADELPHIA: 233 Drexel Building. CLEVELAND: 39-47 E. Prospect Street. SAN FRANCISCO: 598 Parrott Building, A. E. BROOKE RIDLEY.

MARTIN J. INSULL CO.

CHICAGO: 1013 Monadnock. MINNEAPOLIS: 616 Quaranty Building. MILWAUKEE: 700 Pabst Building. ST. LOUIS: 511 Security Building.

10-AMPERE, DOUBLE-POLE.
(Face-Plate removed and side of base cut away to show details.)



RELIABLE; DURABLE;
EASY TO PUSH; EASY TO WIRE;
PURE MICA INSULATION.

YOU MAY BE INTERESTED

In Switches. If so, it would pay you to examine our new

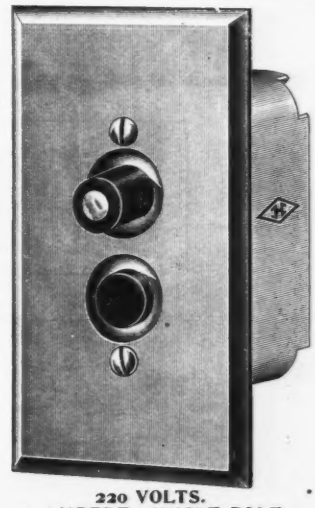
"DIAMOND H" SWITCH OF PURE MICA INSULATION.

The switch is very carefully manufactured of the best material, having perfect insulation of the current-carrying parts, positive mechanism and good contacts.

A TRIAL WOULD SATISFY YOU OF ITS MERITS.

SEND FOR CIRCULAR.

THE HART MFG. CO.,
HARTFORD, - - - - CONN.



220 VOLTS.
10-AMPERE, SINGLE-POLE.
10-AMPERE, DOUBLE-POLE.
10-AMPERE, 3-WAY.

BUCKEYE INCANDESCENT LAMPS

QUALITY UNEQUALED.

THE BUCKEYE ELECTRIC CO.,

11 Broadway, NEW YORK. 753 Monadnock Building, CHICAGO. 552 The Bourse, PHILADELPHIA. 524 Tremont Building, BOSTON.

The Improved Warren Alternator

IT IS ALWAYS READY.

"Since starting up the Warren Alternator we have never had one moment's trouble. We think it the finest machine we ever saw for durability, easy running and regulation."

"We simply don't have to take it into consideration as to whether we are in shape or not, it is always ready for us."

Warren Electric Manufacturing Co.,

SANDUSKY, OHIO.

RUMSEY ELECTRICAL MFG'RS CO., 1217 Filbert St., Philadelphia.
J. H. GATES & CO., 1426 Marquette Bldg., Chicago.
WYBRO-HENDY CO., San Francisco, Cal.
THOS. MUIR & SON, Detroit, Mich.
C. W. HOBSON, Waco, Texas.
C. H. MAXFIELD, Belfast, Maine.
WESTERN ELECTRICAL SUPPLY CO., 10 and 12 N. 9th St., St. Louis, Mo.

"Electricity and Water-Power."

BY MARK A. REPLOGLE.

THE ONLY BOOK OF ITS KIND.

Price, $1.00, Postage Free.

CLOTH, 160 PAGES. ILLUSTRATED.

Pocket Size, 4x6 inches.

A valuable work on the Generation and Transmission of Electrical Energy by Water-Power.

Of vital interest to Engineers, Students, Mechanics, Water-Power Owners and Investors.

Includes descriptions of the most representative Electrical-Water-Power Plants in the United States and Canada.

Electrical Review Publishing Company,

TIMES BUILDING,

New York City.

STANDARD THERMOMETER & ELECTRIC CO.,

Main Office, PEABODY, MASS.

NEW YORK OFFICE, 141 Broadway, W. J. BRAMHALL, Resident Mgr.

CHICAGO OFFICE, 313 S. Canal Street, GEO. H. STOUT, Resident Mgr.

General European Agents, H. M. SALMONY & CO., LTD., LONDON.

ARC LAMPS (OPEN AND ENCLOSED)

FOR ALL CIRCUITS.

THE UPTON "MIDGET" ENCLOSED ARC,

No. 370.

BEST IN THE MARKET.

STEADY WHITE LIGHT.

Single or Double Globe Arrangement.
No Parts to Wear or Get out of Order.
BURNS 125 to 150 HOURS.

Send for Bulletins "Series B."

AGENCIES IN ALL THE LARGE CITIES.

Hart "Standard" Switch.

COVER REMOVED.

You Don't Find Hart Switches in Scrap Heaps or on Bargain Counters.

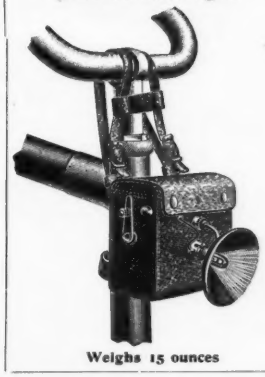
CAUTION. To guard against fraud, all Hart Switches have the words "Hart Switch" stamped in the metal. When you order Hart Switches, make sure that this stamp is on switches received, as inferior switches are sometimes substituted when Hart Switches are ordered.

SOLD BY DEALERS EVERYWHERE.

THE HART & HEGEMAN MFG. CO.
108 HIGH STREET, HARTFORD, CONN.

We Make Dental Surgical Bicycle Novelty and Decorative Lamps of Every Description

Our "LITTLE RHODY" Electric Bike Light

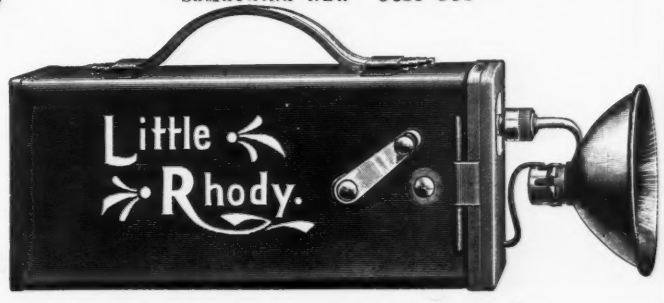


Weighs 15 ounces

Something New ..All The.. Time

AMERICAN ENDOSCOPIC CO.
Weybosset and Union Streets
PROVIDENCE, R. I.

THE "LITTLE RHODY" ELECTRIC LIGHT
SOMETHING NEW JUST OUT



THE ONLY UP-TO-DATE ELECTRIC HAND-LIGHT ON THE MARKET.

Send for our printing and see what we make.

CHLORIDE ACCUMULATORS

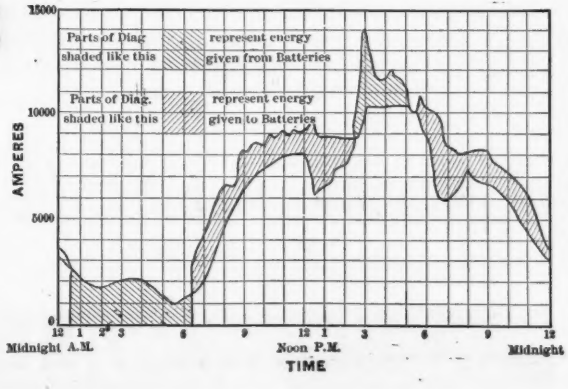
In the Sansom Street Station of

The Philadelphia Edison Electric Light Co.

BATTERY CAPACITIES.

15200	ampere-hours	at	1520	amperes	discharge.
11250	"	"	3750	"	"
9000	"	"	4500	"	"
7500	"	"	7500	"	"

12.30 A. M. to 6.30 A. M. Battery discharging, carrying entire load, generators shut down.
6.30 A. M. to 2.30 P. M. Battery charging.
2.30 P. M. to 5.15 P. M. Battery discharging to assist generators.
.00 P. M. to Midnight Battery charging.



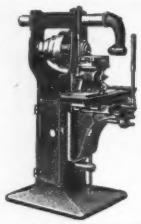
Manufactured and Installed by

The Electric Storage Battery Co.

DREXEL BUILDING,
PHILADELPHIA.

Bulletins describing this and other installations of Chloride Accumulators in lighting and power plants will be furnished upon request.

SALES OFFICES:
New York, 20 Broad St.
Boston, 60 State St.
Baltimore, Equitable Building.
Cleveland, New England Building.
Chicago, Marquette Building.
San Francisco, The Parrott Building.



THE GARVIN MACHINE CO.

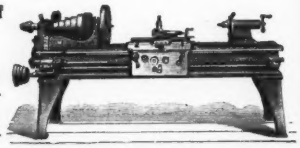
SPRING AND VARICK STREETS, N. Y.

BUILDERS OF

MACHINE TOOLS

Special and Automatic Machinery built to drawings.

Machinery for the manufacture of Electrical Goods.



Philadelphia Store: The Garvin Machine Co., 51 North 7th Street, Philadelphia, Pa.

Berlin Store: The Garvin Machine Co., m. b. H., 17 Burg Strasse, Berlin, C, Germany.

LATHES, PUNCHES AND SHEARS.

Send for Price-List and Catalogue.

W. C. YOUNG MFG. CO.,

Box 1123, WORCESTER, MASS.

Telegraph Address, Young Worcester, Western Union Code Used.

C. & H. SELF-STARTERS FOR PUMPS .....AND ELEVATORS,

do the right thing at the right time, any time, and all the time. Prices are also right. Write us.....

THE CUTLER-HAMMER MFG. CO.,

76 W. JACKSON BLVD., CHICAGO.
136 LIBERTY STREET., NEW YORK.

The largest exclusive manufacturers of rheostats in the world.

CARY SPRING WORKS,

240 & 242 WEST 29th STREET, NEW YORK CITY.

Manufacturers of

WIRE and SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all kinds of Electrical Purposes.

3--Electrical Catalogues--FREE

"LIGHTING," "TELEPHONE," "HOUSEHOLD SUPPLIES."

Sent Free. FRANK H. STEWART & CO., 25 N. 7th Street, Philadelphia, Pa.

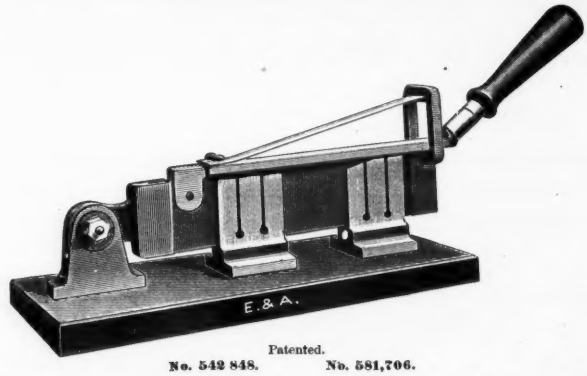
RUBBER COVERED

WIRES AND CABLES FOR EVERY SERVICE.

For Underground, Aerial and Submarine use, "Safety" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.

THE SAFETY INSULATED WIRE & CABLE CO.,
225 to 239 West 28th Street, New York.

LEONARD F. REQUA, General Manager.



Patented.
No. 542 848. No. 581,706.

"S. P." SWITCH for Railroad Circuits.

EYANSON & ARMPRIESTER,

No. 19 North 7th Street, PHILADELPHIA

Full of Life and Even Temper!
SMALL
SPRINGS
OF EVERY DESCRIPTION MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U. S. A.
ESTABLISHED 1857
FLAT OR ROUND WIRE. STEEL OR BRASS. A complete assortment of high-grade COLD ROLLED STEEL kept in stock, 003 to .049 inch thickness.
Springs enameled or plated. Tempering done at short notice. Ribbon steel made to order.
Send samples and write for quotations.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc.

Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

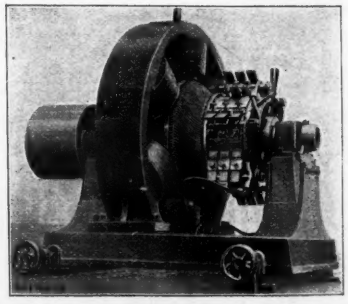
F. N. MANROSS, Forestville, Conn.

GENERATORS:

Multipolar and Bipolar, for Lighting, Power and Electro-Plating.

MOTORS:

For All Classes of Service.

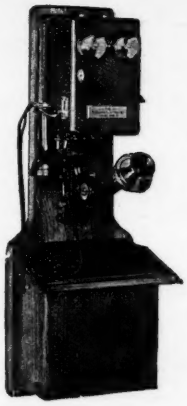


THE QUAKER CITY ELECTRIC CO.,

PHILADELPHIA.

Write for Sheet M. P.-21.

FOREST CITY ELECTRIC CLEVELAND O. **ROLL DROP** COMMUTATOR BARS HAVE STOOD THE TEST OF TIME



No. 25.

POSITIVELY THE BEST.

We do not manufacture **cheap** apparatus, but have **spared no pains** to make our product not only **attractive in appearance** but of the **highest degree of perfection,** electrically and mechanically, yet attained.

Our efforts have met with the earnest and gratifying support of all who have given our goods a trial.

We assure you, you will be **making a mistake** unless you examine our No. 25 'phones before placing your large orders.

Our **magneto bells, receivers, switchboard generators and transmitters LEAD THE WORLD.**

THE WILLIAMS ELECTRIC CO.,

CLEVELAND, OHIO.

THE NEW GORDON

LONG DISTANCE

Adjustable Transmitter Arm

Can be raised, lowered or swung laterally, instantly, to suit the user. Transmitter is held in a horizontal position always.

A. Y. GORDON, Patentee and Manufacturer,

MASSILLON, OHIO.

Lowest Price on Market!!

WATCH-CASE RECEIVER SWITCH.

Highest Grade Goods Only.

TABER & MAYER CO.

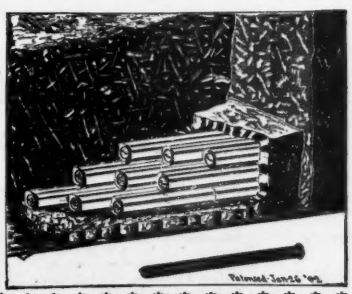
We are manufacturers, and not only sell complete telephones, but everything pertaining thereto. Our special telephone parts, switches, pushes, transmitters and receivers are in great demand. Be sure and get our prices on these parts, especially our three styles of transmitter.

506 Atlantic Avenue,

BOSTON.

THE H. B. CAMP COMPANY'S

VITRIFIED CLAY CONDUIT



For Underground Telephone, Telegraph or Electric Light Wires.....

This conduit is made of vitrified clay, standard size, three inches internal diameter. We can make any size or multiple of ducts desired. Laid with our patent Mandrel, a perfect alignment is insured. We claim for strength, economy, durability, simplicity, cheapness and perfect insulation it is the best. In use by the most prominent companies. Any information cheerfully given.

WRITE FOR CATALOGUE.

MANUFACTURED BY

THE H. B. CAMP COMPANY,

AULTMAN, OHIO.

FARIS & THAYER,

52 Broadway, New York,

BANKERS AND BROKERS,

Investment Stocks and Bonds.

All ELECTRICAL STOCKS for CASH or MARGIN.

Members of the New York Stock Exchange. Telephone "1893 Broad."

B. E. GREENE,

Street Railway Securities
Electric Light Securities

36 NEW STREET,

New York.

Telephone "1344 Broad."

PATENTS TRADE-MARKS COPYRIGHTS

EDWARD S. DUVALL,

Solicitor of Patents,

Counsellor in Patent Causes.

Some time connected with the late Benjamin Butterworth, before he retired from practice to assume the office of Commissioner of Patents.

Prompt attention given to all matters before the Patent Office, and applications for patents prepared here at Washington from sketches, photos, or models, in a manner to give highest satisfaction and with **less expense** than you will incur elsewhere. Write and convince yourself of this fact. As an attorney at Washington is indispensable you can save the expense of having two by communicating directly with me.

LOAN AND TRUST BUILDING,

WASHINGTON, D. C.

YOU CAN GET A PATENT

For any invention. Send me particulars and a rough sketch for advice, free by return mail.

IMPORTANT to have your attorney at Washington, saving time and expense.

HENRY S. THORNBERRY, Patent Solicitor,

1427 F STREET, N. W., WASHINGTON, D. C.

IF THE BEST IS NOT TOO GOOD FOR YOU

YOU WILL BE SATISFIED WITH

The Telephone Magazine

...FOR 1899...

If you are interested in the operation or Construction of **Exchanges, Line Construction, Interior Wiring, Modern Exchange Apparatus, Telephone Troubles** and **How to find them,** or in any other branch of Telephony, send us **A DOLLAR BILL** with your name and address and the Magazine will reach you regularly for a year.

Sample copies free.

Special rates to Agents and Clubs.

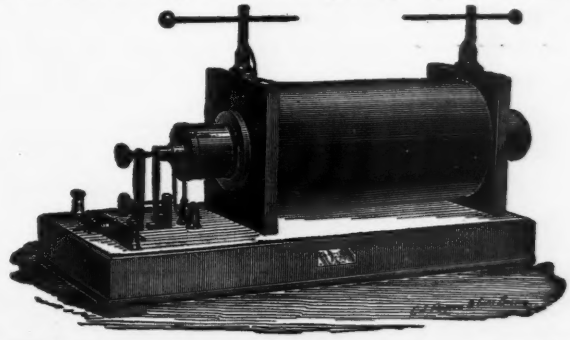
Electrical Engineering Publishing Co.

Monadnock Block, CHICAGO.

NEWSDEALERS SELL IT.

The Ritchie Induction Coils

producing best results in X-Ray work are made by us expresly for this work.



All our coils give a spark from one to two inches above rating. It is known that the founder of this company invented the adopted method of induction coil winding in 1853.

Send for prices and information; catalogue of fine electrical and scientific instruments free.

E. S. RITCHIE & SONS,

Brookline, - - - - - Mass.

INDEX OF ADVERTISERS.

	PAGE
A	
Allen & Co., L. B.	xviii
American Battery Co.	xix
American Bell Telephone Co.	xxvi
American Circular Loom Co.	
American District Steam Co.	ix
American Electrical Heater Co.	xxi
American Electric Telephone Co., long-distance telephones.	xxvi
American Electrical Directory.	
American Electric Vehicle Co.	i
American Electrical Works, insulated wire.	i
American Endoscopic Co.	xiii
American Engine Co.	xxii
American Impulse Wheel Co.	xvii
American Vitrified Conduit Co.	i
Atchison, Topeka & Santa Fe Railway	xxiii
B	
Babcock & Wilcox Co	xxviii
Baker & Co., platinum	xviii
Ball & Wood Co., engines	xxi
Barnes Co., The Wallace	xiv
Becker Name-Plate Co.	
Belknap Motor Co	iv
Bibber-White Co	xxiii
Billings & Spencer Co	i
Boker & Co., Hermann	xxi
Bossert Electric Construction Co.	v
Brady, T. H.	xxii
Bristol Co.	i
Brown-Bierce Co	xvii
Bryant Electric Co.	
Buckeye Electric Co.	viii, xi
Bullock Electric Manufacturing Co.	xix
Bunnell & Co., J. H., dry batteries	vii
C	
Cary Spring Works	xiv
Camp Co., H. B	xv
Central Electric Co., electrical supplies	iii
Central Manufacturing Co.	xxiv
Central Telephone & Electric Co	xxvi
Chicago & Alton R. R.	
Cling-Surface Mfg. Co	
Columbia Automobile Co.	vii
Columbia Incandescent Lamp Co.	
Connecticut Telephone and Electric Co.	
Crefeld Electrical Works.	i
Crocker-Wheeler Electric Co.	i
Cutler-Hammer Manufacturing Co.	xiv
D	
Diehl Manufacturing Co.	iv
Dixon, Jos., Crucible Co., belt dressing.	xxiv
Duval, E. S., Jr., patents	xv
E	
Eastern Electric Cable Co.	xxii
Edison Decorative and Miniature Lamp Department.	xviii
E	
Edison Manufacturing Co.	xvii
Electric Appliance Company, supplies.	i
Electric Storage Battery Co.	xiii
Electrical Engineer Institute of Correspondence Instruction.	xx
Electrical Engineering Publishing Co.	xv
Electric Launch Co.	xxiv
Emerson Electric Manufacturing Co.	v
Empire China Works, porcelain specialties.	x
Ericsson Telephone Co.	xix
Eureka Electric Co.	xxv
Eyanson & Armpriester.	xiv
F	
Faris & Thayer.	xv
Faraday Carbon Co., carbons	xxiv
Fisher Electrical Manufacturing Co	v
Fischer Equipment Co	vii
Forest City Electric Works.	xiv
Frink, I. P.	xxviii
G	
G. & E. Electric Co.	x
Garton-Daniels Electric Co.	xviii
Garvin Machine Co.	xiv
General Electric Co.	vi
General Incandescent Arc Light Co.	xi
Gilmore Electric Co.	xvii
Goldmark & Wallace.	i
Gordon Battery Co.	vi
Gordon, A. Y.	xv
Greene, B. E.	xv
H	
Hart & Hegeman, electric switches.	xiii
Hart Manufacturing Co.	xi
Hobart Electric Manufacturing Co.	v
I	
Illinois Electric Co.	ix
Incandescent Electric Light Manipulator Co.	xvii
India Rubber and Gutta Percha Insulating Co.	x
International Correspondence Schools.	xx
Ironclad Resistance Co.	xix
J	
Jones, J., & Son	iii
K	
Kartavert Manufacturing Co.	xviii
Keystone Electrical Instrument Co.	xviii
Klein & Son, Mathias	xx
Knott Apparatus Co., L. E.	xix
L	
Large & Co	xxv
Leffel & Co., James	xxviii
Lombard Water-Wheel Governor Co.	xxviii
Lynn Incandescent Lamp Co.	xviii
M	
Machado & Roller.	ix
Manross, F. N	xiv
Marietta Manufacturing Co.	iii
Marshall, Wm., condensers.	xxvi
McCay Engineering Co.	xviii
McLeod, Ward & Co.	x
McIntire Co., The C.	xix
McKenney & Waterbury.	
Meserve, F. W.	vi
Mianus Electric Co.	xxv
Michigan Pipe Co.	xx
Mona Manufacturing Co.	xix
Monarch Manufacturing Co.	xxiv
Montauk Multiphase Cable Co.	i, xxiii
Morris, Elmer P.	
Munsell & Co., Eugene.	i
N	
National Automatic Telephone Co.	xxv
National Carbon Co.	ix
National Conduit & Cable Co.	i
National India Rubber Co.	i
New England Butt Co.	iii
New England Engineering Co.	iv
New York Central Railroad Co.	
New York & Ohio Co.	
New York Insulated Wire Co., Grimshaw wires and cables.	
New York Telephone Co	xxvi
North Electric Co.	
Norton Electrical Instrument Co.	x
Novelty Electric Co., supplies.	xxii
O	
Ohio Electric Specialty Manufacturing Co.	xxv
Ohio Electric Works.	x
Okonite Co., insulated wires and cables	i, xxviii
Ostrander, W. R., & Co., supplies	xxiv
P	
Paiste, H. T., Co.	xxiii
Pettingell-Andrews Co.	
Pelton Engineering Co.	xxi
Phoenix Battery Co.	i
Phoenix Glass Co.	i
Phillips Insulated Wire Co	xxviii
Purdue University	xix
Q	
Quaker City Electric Co.	xiv
R	
Reliable Electric Manufacturing Co.	xxv
Ritchie & Sons.	xv
Robbins & Myers Co., The	viii
Roche, Wm.	xxv
Roebling's Sons Co., John A.	xxvii
Rose Polytechnic Institute.	xix
Rossiter & McGovern.	
S	
Safety Insulated Wire & Cable Co.	xiv
Samson Cordage Works.	xxviii
Sawyer-Man Electric Co.	
Schiff, Jordan & Co.	
Shelby Electric Co.	i
Siemens & Halske Electric Co.	xxvii
Simplex Electrical Co.	i
Sperry, B. N.	xx
Sprague Electric Co.	viii
Standard Electric Time Co.	xxviii
Standard Paint Co.	
Standard Thermometer & Electric Co.	xiii
Standard Underground Cable Co.	
Stanley Instrument Co.	xiii
Stanley & Patterson	i
Stewart, Frank H., Co.	xiv
Sterling, C. B., & Co	xxiv
Sterling Supply & Manufacturing Co.	v
Stirling Co., water-tube boilers.	
Stromberg-Carlson Telephone Mfg. Co.	xxvi
T	
Taber & Mayer.	xv
The Telephone Manufacturing Co.	xxv
Thompson, Son & Co.	xxi
Thornberry, Henry S.	xv
U	
United Correspondence Schools.	xx
United States Battery Co.	xx
U. S. Mineral Wool Co	xxviii
V	
Viaduct Mfg. Co., telephones, etc.	xxvi
Victor Telephone Manufacturing Co.	xxvi
W	
Ward Leonard Electric Co.	xix
Warren Electric & Specialty Co.	i
Warren Electric Manufacturing Co.	xii
Webster, Geo. G.	xix
Wells, Heber.	xix
Western Electric Co.	v
Western Telephone Construction Co.	xxv
Westinghouse Electric & Mfg. Co.	xxvii
Williams-Abbott Electric Co.	xxiii
Williams Electric Co.	xv
White & Co., J. G., engineers and contractors	xx
Whitney Electrical Instrument Co.	ix
Wyckoff Creosoting Co.	xviii
Y	
Young, W. C., Mfg. Co.	xiv

CLASSIFIED LIST.

Alternators.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Arc Lamps. (See "Lamps.")

Batteries, Primary.
Bunnell & Co., J. H.
Burnham Electric Co.
Roche, Wm.

Batteries, Storage.
American Battery Co.
Electric Storage Battery Co.

Battery Material.
Bunnell & Co., J. H.

Bells.
Ostrander & Co., W. R.

Belt Dressing.
Cling-Surface Mfg. Co.
Dixon Crucible Co., Joseph.

Boilers.
Babcock & Wilcox Co., The
Stirling Co., The

Books, Technical.
Electrical Review Pub. Co.

Brokers.
Faris & Thayer.
Greene, B. E.

Brushes, Dynamo.
Crown Woven Wire Brush Co.
Goldmark & Wallace.
Hobart Electric Mfg. Co.
Ohio Electric Specialty Mfg. Co.

Cable Hangers.
Standard Underground Cable Co.

Carbon Points.
Faraday Carbon Co.
National Carbon Co.
Reisinger, Hugo.

Circuit-Breakers.
Ward Leonard Electric Co.

Coal Mining Machinery.
General Electric Co.

Commutator Bars and Repairing.
Forest City Electric Works.

Commutator Lubricant.
Mona Manufacturing Co.
Ohio Electric Specialty Mfg. Co.

Condensers (Electric).
Marshall, Wm.

Conduits.
American Circular Loom Co.
American Vitrified Conduit Co.
Camp Co., H. B.
Michigan Pipe Co.
National Conduit & Cable Co.
Wyckoff Creosoting Co.

Connectors and Terminals.
McIntire Co., The C.

Copper Gaskets.
U. S. Mineral Wool Co.

Cord Electric.
Samson Cordage Works.

Contractors.
Webster, Geo. G.

Desk Lamps.
McLeod, Ward & Co.

Dynamos and Motors.
Bullock Electric Mfg. Co.
Central Electric Co.
Crocker-Wheeler Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Hobart Electric Mfg. Co.
Illinois Electric Co.
Lincoln Electric Co.
Warren Electric Manufacturing Co.
Westinghouse Electric & Mfg. Co.

Electric Locomotives.
General Electric Co.

Electric Novelties.
Ohio Electric Works.

Electric Heaters.
American Electrical Heater Co.

Electrical Instruments.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Keystone Electrical Instrument Co.
Whitney Electrical Instrument Co.

Electric Soldering Irons.
American Electrical Heater Co.

Electric Launches.
Electric Launch Co.
Sterling & Co., C. B.

Electrical Supplies.
Bibber-White Co.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Appliance Co.
Illinois Electric Co.
Jones, J., & Son.
Novelty Electric Co.
Ohio Electric Works.
Stewart, Frank H., & Co.
Western Electric Co.

Electric Vehicles.
American Electric Vehicle Co.
Columbia Automobile Co.
Fischer Equipment Co.

Engineers and Contractors.
McCay Engineering Co.
New England Engineering Co
White & Co., J. G.

Engines.
American Engine Co.
Ball & Wood Co.
Monarch Mfg. Co.

Fans and Fan Motors.
Bates, D. L., & Bro.
Central Electric Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co
Illinois Electric Co.
Marietta Mfg. Co.
Paragon Fan & Motor Co.
Robbins & Myers Co., The.
Warren Electric & Specialty Co.

Fiber.
Kartavert Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.

Instruments (Testing and Recording:)
Bristol Co., The
General Electric Co.
General Incandescent Arc Light Co.
Machado & Roller.
Keystone Electrical Instrument Co.
Stanley Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Kartavert Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Junction Boxes.
Bossert Electric Construction Co.
General Incandescent Arc Light Co.
Ward Leonard Electric Co.

Lamps, Arc.
Central Electric Co.
Diehl Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Standard Thermometer & Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative.
Central Electric Co.
Edison Decorative & Miniature Lamp Co.
General Incandescent Arc Light Co.

Lamps, Incandescent.
American Endoscopic Co.
Buckeye Electric Co.
Edison Decorative & Miniature Lamp Co.
General Electric Co.
General Incandescent Arc Light Co.
Gilmore Electric Co.
Lynn Incandescent Lamp Co.
New York & Ohio Co.
Ohio Electric Works.
Sawyer-Man Electric Co.
Shelby Electric Co.
Sperry, B. N.
U. S. Battery Co.
Warren Electric & Specialty Co.
Westinghouse Electric & Mfg. Co.

Lightning Arresters.
Garton-Daniels Electric Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Machine Tools.
Garvin Machine Co.

Mast-Arms.
Brady, T. H.
Meserve, F. W.

Mica.
Munsell, Eugene.

Name-Plates.
Becker Name-Plate Co.

Non-Magnetic Watches.
Becken, A. C.

Paint.
Standard Paint Co.

Patent Solicitors.
Duvall, Edw. S.
Thornberry, Henry S.

Pattern Letters.
Wells, Heber.

Platinum.
Baker & Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.
Morris, Elmer P.
Roebling's Sons Co., John A.

Railway Specialties (Electric).
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.

Rheostats.
Cutler-Hammer Mfg. Co.
Ohio Electric Specialty Mfg. Co.
Ward Leonard Electric Co.

Schools.
American School of Correspondence.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools.
United Correspondence Schools.

Soldering Sticks.
Allen & Co., L. B.

Specialties.
G. & E. Electric Co.
General Incandescent Arc Light Co.
Ohio Electric Works.

Steam Engine Stops.
Monarch Mfg. Co.

Steel Spring Wire.
Boker & Co., Hermann.
Cary Spring Works
Manross, F. A.
Wallace Barnes Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Large & Co.
Western Electric Co.

Switches, Etc.
Central Electric Co.
Eyanson & Armpriester.
General Electric Co.
General Incandescent Arc Light Co.

Switches, Etc.
Bryant Electric Co.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Jones & Son, J.
Large & Co.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Bunnell & Co., J. H.
Central Electric Co.
Central Telephone & Electric Co.
Connecticut Telephone & Electric Co.
Eureka Electric Co.
Farr Telephone and Construction Co.
Gordon, A. Y.
Illinois Electric Co.
Mianus Electric Co.
Murdock & Co., Wm. J.
National Automatic Telephone Co.
New York Telephone Co.
North Electric Co.
Ohio Electric Works.
Pennsylvania Electric Co.
Reliable Electric Mfg. Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg. Co
Telephone Mfg. Co.
Viaduct Mfg. Co.
Victor Telephone Mfg. Co.
Western Electric Co.
Western Telephone Construction Co.
Williams-Abbott Electric Co.
Williams Electric Co.

Tools.
Garvin Machine Co.

Transformers.
New York & Ohio Co.
Westinghouse Electric & Mfg. Co.

Turbine Governors.
Lombard Water-Wheel Gov. Co.

Voltage Regulators.
Belknap Motor Co.

Water-Wheels.
Leffel & Co., Jas.

Wires and Cables.
American Electrical Works.
Central Electric Co.
Crefeld Electrical Works.
Eastern Electric Cable Co.
Electric Appliance Company.
General Electric Co.
Indiana Rubber and Insulated Wire Co.
India Rubber & Gutta Percha Insulating Co.
Montauk Multiphase Cable Co.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Novelty Electric Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Taber & Mayer.
Western Electric Co.

X-Ray Apparatus.
Knott Apparatus Co., L.
Ritchie & Sons.

Gilmore Lamps and Rosettes

N. B. { You can exchange your burned-out lamps and bases without expense for strictly new lamps.

HIGHEST QUALITY.
LOWEST PRICES.
LARGE STOCK.

Write for Particulars.

GILMORE ELECTRIC COMPANY,

M and First Streets, SO. BOSTON, MASS.

JUST OUT

The Incandescent ELECTRIC LIGHT MANIPULATOR

For cleaning and renewing Incandescent Lights situated in high places. Made to fit any candle-power bulb of any standard make and at any angle.

JUST WHAT IS NEEDED

for Halls, Theatres, Public Buildings, Street Lights, Stores, Etc. Send for description and price.

AGENTS WANTED IN EVERY CITY IN UNITED STATES.

Incandescent Electric Light Manipulator Co.
Room 506
116 Bedford St., BOSTON, MASS.
Lately Exhibited at Electrical Exhibition, New York.

DESIGNERS AND ENGRAVERS
BY ALL METHODS
Electrical Machinery and Apparatus
A SPECIALTY
GET OUR PRICES AND SPECIMENS BEFORE BUYING.

THE BROWN-BIERCE COMPANY.
DAYTON, OHIO.

THE EDISON TELEPHONE BOOTH FAN MOTOR OUTFIT. INDORSED BY THE LONG DISTANCE TELEPHONE CO.

PERFECTLY NOISELESS.

NO VIBRATION.

KEEP COOL WHEN YOU USE YOUR TELEPHONE.

FULL DESCRIPTION IN BOOKLET NO. 17.

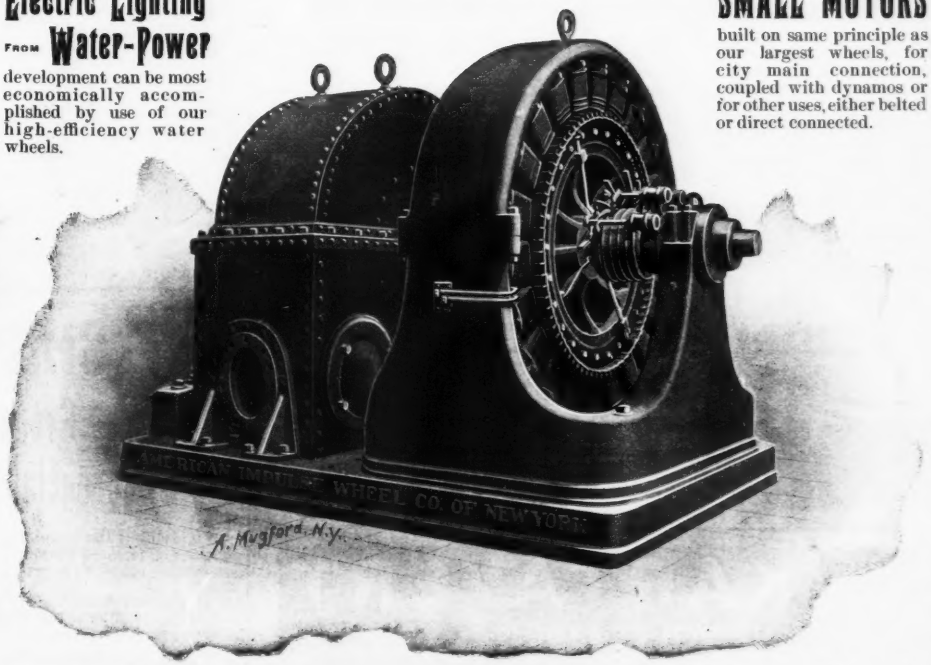
EDISON MANUFACTURING COMPANY,
THOMAS A. EDISON, PROPRIETOR.
135 FIFTH AVENUE, NEW YORK.

WATER WHEELS FOR Electric Transmission

MANUFACTURED BY

Electric Lighting FROM Water-Power
development can be most economically accomplished by use of our high-efficiency water wheels.

SMALL MOTORS
built on same principle as our largest wheels, for city main connection, coupled with dynamos or for other uses, either belted or direct connected.



American Impulse Wheel Co. of New York

120 & 122 LIBERTY STREET, NEW YORK

PLATINUM

IN SHEET OR WIRE, ANY SIZE, SHAPE OR DEGREE OF HARDNESS, FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. RAILROAD AVE., NEWARK, N. J.

NEW YORK OFFICE, 120 LIBERTY STREET.

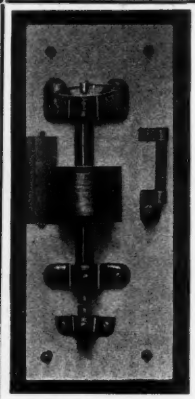
Scrap and Native Platinum Purchased.

EVERY ONE KNOWS

or ought to know, that we lead in the manufacture of Candelabra, Series, Decorative, Battery and Miniature lamps. Our latest Catalogue (No. 1017) to be had for the asking.

Some of our special X-Ray tubes have Iridium targets. The regulars have Platinum targets. We are still making the best Barium fluoroscopes.

EDISON DECORATIVE & MINIATURE LAMP DEPT.
(General Electric Co.),
Harrison, N. J.



It's not as wide as a

Cambric Needle.

Yet such a little ribbon of lightning can impair your entire service, unless you are properly protected.

GARTON LIGHTNING ARRESTERS

are prominent among the leaders. They have the smallest air-gap, and do not ground your circuits.

Every little storm does not "knock them out," and their cost is but little compared with the cost of repairs and inconvenience.

GARTON-DANIELS ELECTRIC CO.,
KEOKUK, IOWA, U. S. A.

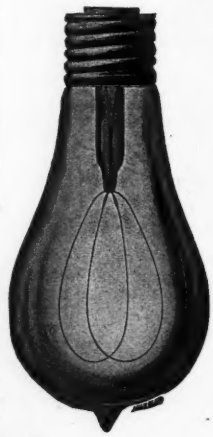
Do You Know

That your ELECTRIC Light can be REGULATED as easily and economically as GAS?
Send us your order for regulating Sockets.

McCay Engineering Co.

No. 108 E. German St., Baltimore, Md.

State base, voltage and ALTERNATIONS



LYNN LAMP.

OVAL ANCHORED FILAMENT.
EXTRA SHORT BASE.
UNIFORM MOULDED BULBS.

The MOST SYMMETRICAL RELIABLE EFFICIENT CAREFULLY MADE AND TESTED LAMP ON THE MARKET.

All Candle-Powers, Voltages and Efficiencies.

LARGE STOCK.
PROMPT SHIPMENTS.
GOODS GUARANTEED.

WRITE FOR PRICES.

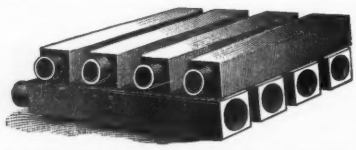
LYNN INCANDESCENT LAMP CO., LYNN, MASS.

THE ALLEN SOLDERING STICK
Non-Corrosive, Convenient, and Effective
A SUBSTITUTE FOR RESIN, ACIDS, AND SOLDERING SALTS.
FOR ALL ELECTRIC WORK

MANUFACTURED EXCLUSIVELY BY

L. B. ALLEN CO.,

6359 STAR AVE., CHICAGO, ILL., U. S. A.



THE WYCKOFF CREOSOTING CO.,
WILLIAMSPORT, PA.
MANUFACTURERS OF
WYCKOFF WOODEN CONDUITS,
Also Poles and Cross-Arms.

KARTAVERT

FIBER! FIBER! FIBER!

HARD AND FLEXIBLE. IN SHEETS, RODS AND TUBING.

For ELECTRICAL and Mechanical purposes, Railway dust guards, Washers and packings.

MANUFACTURED BY
THE KARTAVERT MANUFACTURING CO., Wilmington, Del.
P. O. BOX 625.

SWITCHBOARD VOLTMETERS

Ammeters, Ground Detectors and Differential Voltmeters.

TYPE "R."

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating-current circuits.

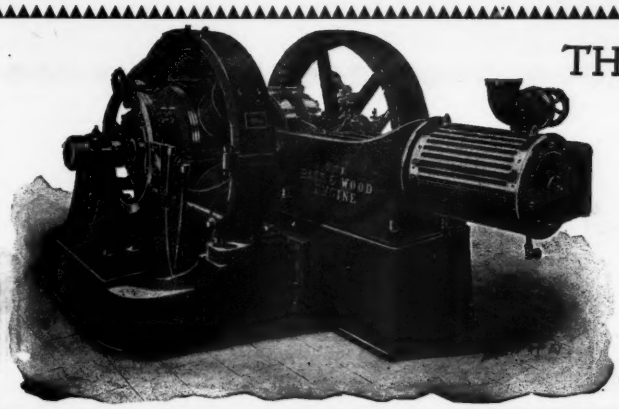
Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.

We also manufacture a full line of Portable Instruments. Send for our complete catalogue.

Keystone Electrical Instrument Co.,

Ninth Street and Montgomery Avenue,
PHILADELPHIA.

NEW YORK, 15 Cortlandt Street. CHICAGO, 231 S. Canal Street.



THE BALL & WOOD HIGH-SPEED ENGINE

is noted for its smooth and silent running, and its extremely low cost of maintenance. It is recognized as the standard engine for electric light and railway plants. Ball & Wood engines are made in all types for all services requiring the best economy and efficiency.

THE BALL & WOOD CO.,

Works, Elizabethport, N. J. 120 LIBERTY ST., NEW YORK CITY.

THE PELTON ENGINEERING CO.

CLEVELAND OHIO.

DYNAMOS
MOTORS
LAMPS.

Our Bargain Counter.

One 40-K.W. Westinghouse Multipolar Generator, 500 volts, late type, fine condition, warranted	$425 00
One 20-K.W. Western Electric, 110 volts, ring oiler, self-aligning bearings, medium speed, nearly new, warranted	295 00
One 8-K.W. National, 110 volts, overhauled and warranted	165 00
One Extra ring Armature, for T-H, MD2, Arc Dynamo	135 00
One M12, T-H Arc Dynamo, 45-lt., 1,200 c p., overhauled and warranted	235 00
One LD2, T-H Arc Dynamo, 35-lt., 2,000 c.p., overhauled and warranted	225 00
One No. 7, Brush Arc Dynamo, 30-lt., 2,000 c.p., overhauled and warranted	210 00
One 45-K.W. Edison, 500 volts, late type, fine condition	500 00
Extra Armature, for above dynamo	135 00
One 65-K. W. Detroit Dynamo, 500 volts, fine condition, warranted	400 00

Nearly 1,000 Arc Lamps. Open arc and series enclosed, Brush, T-H., Manhattan and other standard makes, at rock bottom prices.

IF YOU DON'T SEE WHAT YOU WANT ASK FOR IT.

REPAIRING REWINDING. "BRUSH" ARC SUPPLY PARTS. "PELTON ENG. CO." INCANDESCENT LAMPS. STATION SUPPLIES.

ELECTRIC LAUNDRY IRONS.

No. 72.

V-Shaped.
Weight, 8 lbs.
Consumes 550 watts.
Any voltage up to 220.

No. 62.

Oval-Shaped.
Weight, 6½ lbs.
Consumes 450 watts.
Any voltage up to 220.

MANUFACTURED BY

American Electrical Heater Co.,

DETROIT, MICH.

DO YOU USE RESISTANCE WIRES?

BOKER'S SUPERIOR WIRE has three times the resistance of german silver; suitable for resistance in arc lamps, rheostats, etc.

BOKER'S I-I WIRE gives increase of resistance for each centigrade .000005; 1⅔ times the resistance of german silver.

We can furnish both grades in wire, sheets or ribbon.

STEEL MUSIC WIRE.

We are importers of the celebrated steel music wire made in Hagen, Germany, by **Messrs. EICKEN & CO.** This wire has gained a world-wide reputation for quality, uniform temper and accuracy of size. Wherever used it has been adopted in preference to other brands. We carry large stock of listed sizes.

SPECIAL MAGNET STEEL is now being made by **Messrs. JONAS & COLVER, Ltd.,** which answers requirements and demands never fully met before. The steel is of exceptional quality; carries an astonishing weight and retains the magnetism.

The largest companies, after elaborate tests, have adopted Messrs. Jonas & Colver's Special Magnet Steel, as it proved superior to any other steel for permanent magnets.

We also manufacture **PURE MALLEABLE NICKEL** in Wire and Sheets. *WESTFAELIAN NICKEL ROLLING MILL, SCHWERTE, GERMANY.*

HERMANN BOKER & CO.,

Send for catalogues, etc. 101 & 103 DUANE STREET, NEW YORK.

FOR SALE BARGAINS.

NEW AND GOOD SECOND-HAND

ALTERNATORS.	ENGINES.	FAN MOTORS, TRANSFORMERS, ETC.	
2—60 K.-W., Westinghouse, 16,000 Alternations	1—Russell Automatic	50—Emerson Fan Motors, Alternating, 52 and 104 volts.	$5 00 Each.
Iron-Clad Armature, S. O. Bearings	17 x 24 Porter Cut-off	50 G. E. Co. " " 125 Cycle, 104 volts	7 50 "
2—60 K.-W., Slattery, 16,000 Alternations	2—Russell Automatic	25—Westinghouse " " " "	7 50 "
Smooth Body Armature, S. O. Bearings	14 x 20 Outboard Bearings	11—Dayton Ceiling Fans, 110-volt, D. C.	11 00 "
1—120 K.-W. Thomson-Houston-General Electric, 16,000 Alt.	1—15 x 23 x 17 Tandem	2—W. E. Co. " " "	11 00 "
Iron-Clad, S. O. Bearings	Compound McIntosh-Seymour	1—Hunter " " "	11 00 "

THE ABOVE ARE READY FOR IMMEDIATE DELIVERY AND ARE STRICTLY FIRST-CLASS.

Also Transformers, Arc and Incandescent Dynamos, Railway Motors, etc.
Correspond with us to buy or sell.

THOMPSON, SON & CO., 107 Liberty St., New York, U. S. A.

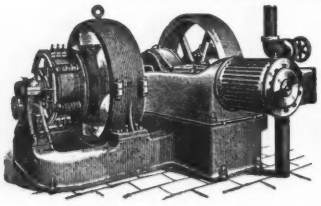
NOVELTY ELECTRIC CO.,

PHILADELPHIA, PA.

Agents for
- Okonite Insulated Wires.
- Medbury Overhead Railway Material.
- Changeable Electric Headlights.
- Globe Metal Works' Trolley Wheels.
- P & B Electrical Compounds.
- Perkins Incandescent Lamps.
- Schiff, Jordan & Co.'s Ship Cored Carbons.

ELECTRICAL SUPPLIES OF EVERY KIND.

AMERICAN-BALL ENGINES and
ELECTRIC MOTORS and GENERATORS
BOTH
BELTED and
DIRECT-CONNECTED.



AMERICAN ENGINE CO.,
48 RARITAN AVE., BOUND BROOK, N. J.
New York Office, 97 Liberty St.

THE
BRADY
MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.
Manufacturer of
Mast-Arms, Pole and Swinging Hoods,
Arc Cutout Boxes, Fuse Boxes,
Knife Switches, Brackets,
Hanger Boards, &c.

Catalogues and Prices furnished on application.

THE "CLARK" WIRE

FOR SWITCHBOARD, RAILWAY AND MOTOR USE.
All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—A thoroughly reliable and durable wire in every respect."

The Clark wire has been before the public, and in use, for the past 10 years, and has met with universal favor. We guarantee our insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,
HENRY A. CLARK, Treasurer and General Manager.
HERBERT H. EUSTIS, President and Electrician.
61-63 Hampshire St., BOSTON, MASS.

JUST... ISSUED.

A new catalogue of electrical books has been prepared by the ELECTRICAL REVIEW and is now ready for distribution.

Sent Free on Request...

It is the most complete and satisfactory electrical book catalogue ever prepared.

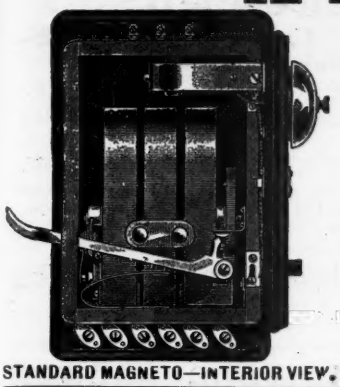
The Electrical Review
BOOK DEPARTMENT

will send **any electrical book** to **any address** in the world, postage prepaid, on receipt of catalogue price.

Any inquiries addressed to **The Electrical Review Book Department** will receive prompt attention.

Electrical Review Publishing Company,
41 Park Row,
NEW YORK.

A BELL THAT IS A BELL.



STANDARD MAGNETO—INTERIOR VIEW.

THE WILLIAMS-ABBOTT MAGNETO BELL.

Perfect. Electrically and Mechanically.

EVERY ONE GUARANTEED.

Why not get the best when you can get it at cost of poorest.
Our bell will outlive TWO of ordinary kind.

GET OUR PRICES.

Examine and test before closing any contracts.

THE BEST TELEPHONE BELLS AND RECEIVERS ON THE MARKET.

SEND FOR DESCRIPTION AND PRICES.

Correspondence Solicited. Patents Bought and Manufactured on Royalties.

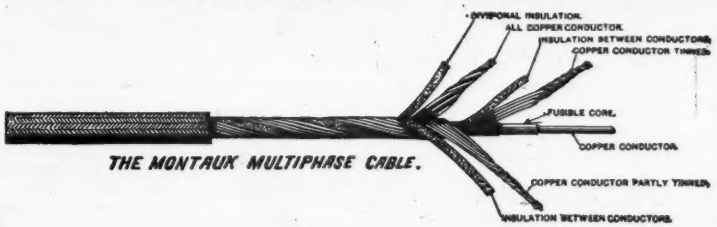
THE WILLIAMS-ABBOTT ELECTRIC COMPANY,

8, 10 and 12 Columbus St. CLEVELAND, OHIO.

OUR TESTING BELL.

THE MONTAUK MULTIPHASE CABLE

The only Fire Detective Cable in the World.



THE MONTAUK MULTIPHASE CABLE.

Being thermostatic in every infinitesimal part, it is alive to any dangerous heat or flame and gives automatic warning of same TO ANY DESIRED POINT. It is so constructed that it can be used in place of plain wire for all interior adaptions such as bells, telephone, district service, etc. It saves the expense of a watchman by acting as a burglar alarm, giving instantaneous warning when cut or disturbed in any way.

HAS PROVED THOROUGHLY SUCCESSFUL WHEREVER INSTALLED.

Adopted by Gamewell Auxiliary Fire Alarm Company. Montauk Cables are small, neat, flexible and perfectly insulated. Furnished in dampproof, waterproof or decorative construction, and in any desired color or length. Conductors are standardized to equal carrying capacity. Samples and descriptive matter on application. Use demonstrated at our office.

MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York. Telephone, 4031 Cortlandt.

N. E. A. Convention

Los Angeles, Cal., July 11-14, 1899.

The Santa Fe Route

Is the most comfortable summer route.

It provides the best dining-car and eating-house service in the world.

It is 24 to 36 hours shorter to Los Angeles than any other line.

This route presents scenes of extraordinary interest to the educated traveler, which are fully set forth in the following illustrated descriptive books, mailed free on application:

To California and Back, 176 pp., 176 illustrations.
The Moki Snake Dance, 60 pp., 64 illustrations.
New Mexico Health Resorts, 88 pp., 45 illustrations.
Grand Canon of Arizona, 32 pp., 15 illustrations.
Las Vegas Hot Springs, 48 pp., 39 illustrations.
Arizona Health Resorts, 84 pp., 27 illustration.

The Summer climate of Southern California is delightful. The midsummer temperature of Los Angeles, San Diego, Coronado, and Santa Barbara, is lower than that of most Eastern cities.

Address E. F. Burnett, G. E P. A.
The Atchison, Topeka & Santa Fe Railway,
377 Broadway, New York, N. Y.

Correspondence Solicited.

Customers pay for advertising, and therefore appreciate brevity.

PAISTE ATTACHMENT PLUGS HAVE PORCELAIN BASE AND CAP.
PAISTE ROSETTES HAVE KNIFE-SWITCH CONTACTS.
JENKINS SNAP-SWITCH CONTACTS ARE GROUND TO A FIT.

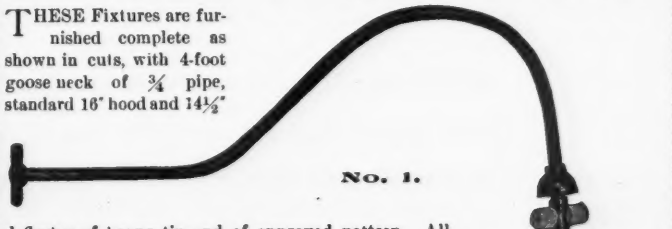
H. T. PAISTE CO.,

PHILADELPHIA. CHICAGO.

B. W. CO.

STANDARD STREET FIXTURES

THESE Fixtures are furnished complete as shown in cuts, with 4-foot goose neck of ¾ pipe, standard 16" hood and 14½"



No. 1.

deflector of heavy tin and of approved pattern. All castings of Malleable Iron.

Fixture No. 1 is furnished with porcelain insulators bolted to the fitting. A good strong fixture.

Insulated bushings furnished with all fixtures without extra charge.

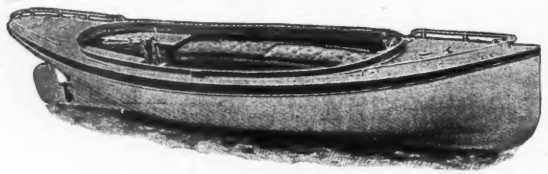
Prices on application. **Jobbers Supplied.**

BIBBER-WHITE COMPANY, Manufacturers,

49 Federal Street, BOSTON.

MONITOR AND MOGUL VAPOR ENGINES

FOR LAUNCHES AND AUXILIARY POWER



C. B. STERLING & COMPANY,

Telephone 3432, Cortlandt. 120 LIBERTY STREET, N. Y.

ELECTRIC LAUNCHES.

Newest Types. Motive power below flooring.

SAFE, SIMPLE, RELIABLE.

NO HEAT, NO SMOKE, NO SMELL.

Fully Guaranteed.

CAN'T EXPLODE, CAN'T SINK.

Easily recharged from any direct-current lines, but can be USED EVERYWHERE with our new PORTABLE CHARGING PLANT.

Illustrated Catalogue mailed on request.

The Electric Launch Co.,

MORRIS HEIGHTS, NEW YORK CITY.

DIXON'S GRAPHITED WOOD GREASE

FOR TROLLEY CAR GEARS.

ABSOLUTELY PREVENTS NOISE AND DOES NOT OOZE OUT OF GEAR CASE.

"LASTS THREE TIMES AS LONG AS ANY OTHER LUBRICANT."

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.

FARADAY CARBON COMPANY,

ELECTRIC LIGHT CARBONS

JEANNETTE, PA.

Central Manufacturing Co.

Chattanooga, Tenn.

Manufacturers and Dealers in

Yellow Pine Cross Arms, Locust Pins, Oak Pins, Electrical Mouldings, Oak Brackets.

Large stocks on hand. Delivered prices quoted, F. O. B. cars, your city, in any quantity. Write us.

W. R. OSTRANDER & CO.

99 DEY STREET,

Manufacturers of

SPEAKING TUBES, WHISTLES, ANNUNCIATORS.

Electric and Mechanical Bells.

FACTORY,

DE KALB AVENUE, BROOKLYN.

Send for Illustrated Catalogue.

The Monarch Engine-Stop

—with Speed-Limit

attachment will positively prevent an engine from running away, and also enable it to be stopped from any point in the factory in case of accident, notifying the engineer at the same time. It is a first-class insurance at a low cost. It closes the Throttle-Valve. Why not investigate?

The Monarch Manufacturing Co.,

WATERBURY, CONN.

"IMPERIAL"

IMPERIAL

TELEPHONES AND SWITCHBOARDS ARE

PERFECT

IN ELECTRICAL AND MECHANICAL EFFICIENCY.

THE HIGHEST GRADE INSTRUMENT ON THE MARKET.

A trial is all we ask to convince you of the absolute superiority of our apparatus. Write us for further description and prices.

THE **TELEPHONE MFG. CO.,**

SUMTER, S. C.

TELEPHONES

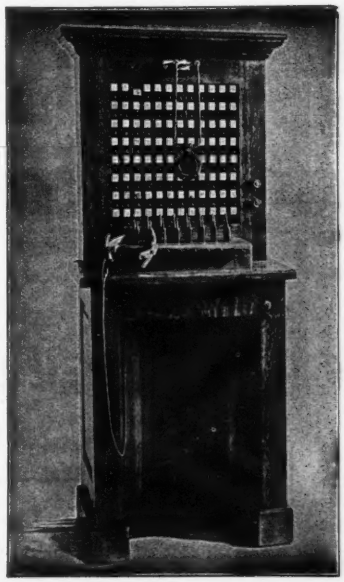
for Intercommunicating and Exchange Work of the Most Careful Mechanical and Electrical Construction.

SEND FOR CATALOGUE AND PRICES.

RELIABLE ELECTRIC MFG. CO.

WORCESTER, MASS.

IT HAS NO BUGS IN IT.



Do you know of any that as much can be said of. Investigate it.

Already installed in a hundred plants.

Its success unequaled.

It is the only board in the market that has supplanted others, and never been supplanted by others.

Can others show this record?

Write for further and fuller particulars.

EUREKA ELECTRIC CO.,

157-59 So. Canal St., Chicago, Ill.

"TELEPHONE HAND BOOK,"

By WEBB.

UP-TO-DATE—$1.00.

Address: ELECTRICAL REVIEW, N. Y.

AUTOMATIC TELEPHONE.

We make 20 different styles of telephones. They are easy to operate, require no hello girls.

Reliable and durable.

You can not afford to buy new equipment without first consulting us.

CENTRAL EXCHANGE.

EXAMPLE:

To call 1562,

remove Receiver, turn pointer to 1 and let it return, then to 5, then to 6 and then to 2.

Ring as usual.

The Bell will not ring on a BUSY LINE.

THE **NATIONAL AUTOMATIC TELEPHONE CO.,**

71-75 West Jackson Boulevard, CHICAGO, and SALINA, KAS.

Western Telephone Construction Co.

250-254 S. CLINTON STREET, CHICAGO, ILL.

Largest Manufacturers of

TELEPHONES AND SWITCHBOARDS EXCLUSIVELY

IN THE UNITED STATES.

EFFICIENCY GUARANTEED. PRICES REDUCED. HIGHEST POSSIBLE CONDUCTIVITY.

PURE COPPER WOVEN WIRE BRUSHES.

Write us, stating size, and let us quote you and send you sample.

Our prices will save you *dollars.*

OHIO ELECTRIC SPECIALTY MFG. CO., TROY, OHIO.

KNIFE SWITCHES * SWITCHBOARDS.

MANUFACTURING ELECTRICIANS.

Send for our Illustrated Catalogue.

STEPHEN D. LARGE & CO.,

Formerly Large & Twining.

323 Chestnut St., PHILADELPHIA, PA.

MAGNETO BELLS.

TELEPHONES

Electrical Supplies.

Send Stamp for Catalogue of Prices.

All Kinds and Parts of Telephones.

MIANUS ELECTRIC CO.,

MIANUS, CT.

New Standard Dry Battery.

U. S. NAVY STANDARD and STANDARD OF THE WORLD

It will please you in every way for open-circuit work. Made in any style from 13-16 to 3 in. diam., and 2 to 7 in. high. The only reliable cell (dry) now before the public.

Will send new Standard Electric Necktie Pin, anywhere, post-paid, for ONE DOLLAR.

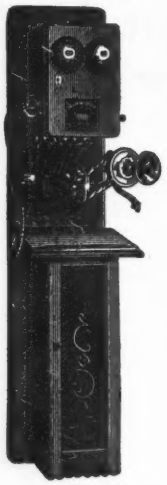
WILLIAM ROCHE,

259 Greenwich Street, NEW YORK,

INVENTOR AND MANUFACTURER.

HIGH-GRADE NON-INFRINGING APPARATUS.

LARGEST MANUFACTURERS OF TELEPHONES AND ACCESSORIES IN THE U. S.



Our new Express System is adapted for use in both large and small exchanges; our Express switchboard is a new departure and possesses original features, being the most rapid switching apparatus ever devised.

SELF-RESTORING DROP.
SELF-RESTORING RING-OFF.
RAPID RINGING DEVICE.

Drops mounted in non-inductive metal shell, combined drop and jack in self-contained hard-rubber case, can be removed and replaced in board in one minute without disturbing connections. Each drop indicates as to whether line is working properly.

WILL PAY A DAILY DIVIDEND IN QUALITY OF SERVICE RENDERED.

OUR AMERICAN SOLID BACK AMPLIFYING TRANSMITTER

is the most powerful instrument yet produced. Especially built for Long and Severe Lines, and for volume of voice transmission, distinctness of articulation, exact reproduction of voice and durable qualities is unequaled.

Manufacturers of full line of devices of high efficiency adapted to meet special requirements of service, including the best Bridging Instruments and Repeating Coils on the market.

OVER 700 FLOURISHING EXCHANGES EQUIPPED.
PROTECTION GUARANTEED TO PATRONS.
EXPERT ADVICE FURNISHED.

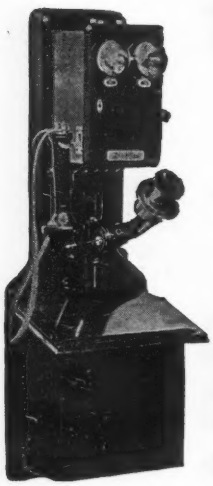
Correspondence solicited. Address

AMERICAN ELECTRIC TELEPHONE CO.

Nos. 171-173 So. Canal Street, Chicago.

SEE OUR EXHIBIT, PARIS EXPOSITION, 1900.

MEDAL AWARDED, COTTON STATES EXPOSITION, ATLANTA, GA., 1895.
MEDAL AWARDED, TENNESSEE CENTENNIAL, NASHVILLE, TENN., 1897.
MEDAL AWARDED, INTERNATIONAL EXPOSITION, OMAHA, NEB., 1898.



TELEPHONE USERS

in the West should

See Our New Catalogue

of instruments and modern telephone appliances.

LOW PRICES AND SPLENDID APPARATUS.

CENTRAL TELEPHONE and ELECTRIC CO.,

909 Market St., **ST. LOUIS, MO.**

When Outdoor Life

begins to resume importance it is well to remember that the Telephone Service reaches everywhere and gets there quicker than anything else.

Message Rates make the cost of telephone service at your house or office very moderate, but there are thousands of public stations available if you are not yet convinced of the value of permanent service at your own place.

NEW YORK TELEPHONE CO.

18 Cortlandt Street. 952 Broadway.
15 Dey Street. 115 West 38th Street.

ELECTRIC CONDENSERS.

WM. MARSHALL, Manufacturer.

STANDARDS A SPECIALTY

709 Lexington Avenue, New York.

EQUIP LARGE EXCHANGES

— WITH —

Central Energy System

— AND —

MULTIPLE SWITCHBOARD.

The most convenient and economical telephone system ever put in use.
Reduces cost for operating and maintenance to a minimum.
Correspondence Solicited.

The Stromberg-Carlson Telephone Mfg. Company,

72-82 W. JACKSON BOULEVARD, CHICAGO, U. S. A.

The Most Reliable General Telephone Apparatus Manufacturers in the World.

The Victor Apparatus

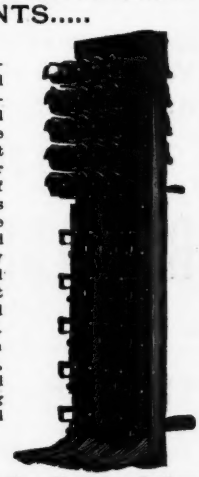
IS FULLY PROTECTED BY PATENTS.....

We make a full line of Telephone Apparatus.

The Victor Express Switchboard

has no wires running into the back or jacks; all others have from three to six. This board is the most satisfactory ever offered to the telephone public. It is durable and simple, containing no useless trappings or superficial parts. It is durable and simple in construction, easy and rapid to operate and inexpensive to maintain. All parts are interchangeable and accessible without interfering with other parts or interruption of operation. This board is built in sections of five drops and jacks, mounted on hard rubber, invisibly wired and so constructed that when assembled it has the appearance and in fact is one solid front. Each subscriber has an individual ringing key, and the gravity drop used is a special feature owing to its positive action and easy restoration.

Front View, Showing 5 Sections Drops and Jacks.



Back View, Showing 5 Sections Drops and Jacks.

Write for information on telephone instruments.

VICTOR TELEPHONE MANUFACTURING CO., 166-174 So. Clinton Street, CHICAGO.

THE AMERICAN BELL TELEPHONE COMPANY,

125 MILK STREET, BOSTON, MASS.

This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.

The Siemens & Halske Electric Co. of America

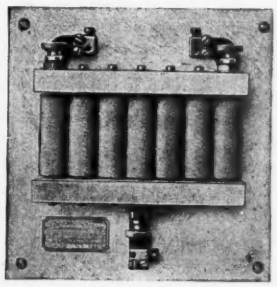
BUILDERS OF

RAILWAY AND LIGHT GENERATORS
ARC APPARATUS
MOTORS, LAMPS
METERS, TRANSFORMERS

BRANCH OFFICES
New York City: 621 Broadway
Philadelphia: Land and Title Building
Boston: 71 and 73 Broad St.
Washington: D. C.. 60 Kellogg Bldg.
Pittsburgh: 1216 Carnegie Bldg.

GENERAL OFFICES
MONADNOCK BUILDING
CHICAGO

BRANCH OFFICES:
Cincinnati: 22 Norris Bldg.
St. Louis: Laclede Bldg.
Denver: 412 17th St.
Salt Lake City: Trent Engineering and [Machinery Co.
San Francisco: 598 Parrot Bldg.



A. C. STATION ARRESTER.

WURTS LIGHTNING ARRESTERS

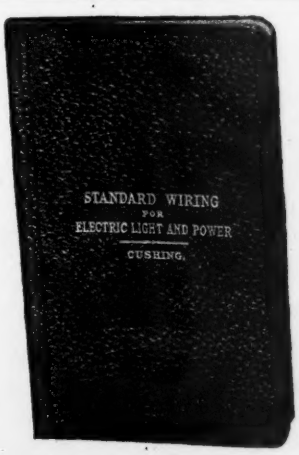
for alternating and direct-current circuits of any voltage. After years of practical experience with this arrester we have yet to find that full protection is not furnished when properly installed.

Westinghouse Electric
& Mfg. Co., Pittsburg, Pa.

D. C. LINE ARRESTER.

Westinghouse Electric Co., Ltd., 32 Victoria St., London, S. W., England. And all principal cities in United States and Canada.

129-c



THE RECOGNIZED AUTHORITY ON WIRING AND CONSTRUCTION.

The Universally Adopted National Electrical Code explained and illustrated in this year's edition of the Handbook.

STANDARD WIRING

For Electric Light and Power.

By H. C. CUSHING, JR., A. I. E. E., Electrical Engineer and Inspector.

ADOPTED { by The Fire Underwriters of the United States.
by Cornell University, Stanford University and Other Technical Colleges and Schools.
by 20,000 Electrical Engineers, Central Station Managers and Wiremen.

BECAUSE { it is the only book on Wiring and Construction kept strictly up to date.
it contains all the necessary Tables, Rules, Formulas and Illustrations
it settles disputes, and if referred to before wiring will prevent disputes.

FLEXIBLE LEATHER COVER (Pocket Size), $1.00. Sent postpaid, upon receipt of price, by

ELECTRICAL REVIEW, 41 Park Row, New York City.

OKONITE
TRADE MARK

1889
PARIS EXPOSITION MEDAL
FOR RUBBER INSULATION.

1893
WORLD'S FAIR MEDAL
FOR RUBBER INSULATION.

THE STANDARD FOR RUBBER INSULATION.

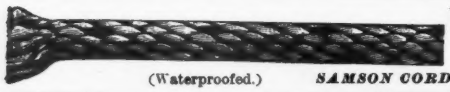
SOLE MANUFACTURERS OF

OKONITE WIRES, OKONITE TAPE, MANSON TAPE,
CANDEE WEATHERPROOF WIRES.

THE OKONITE CO., Ltd.,

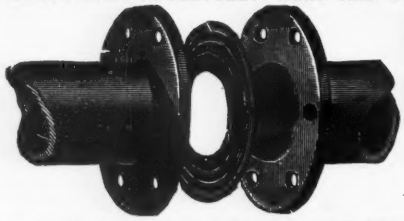
WILLARD L. CANDEE, } Managers.
H. DURANT CHEEVER, }
GEO. T. MANSON, General Supt.
W. H. HODGINS, Secretary.

253 Broadway, N. Y.



SAMSON SPOT CORD
For ARC LIGHT and TROLLEY CORD.
Send for Samples and Prices.
(Waterproofed.) SAMSON CORDAGE WORKS, BOSTON, MASS.

JOINTS MADE ABSOLUTELY TIGHT AND DURABLE BY PATENT CORRUGATED



COPPER GASKETS.

Furnished in all shapes and sizes for Flanged Pipes, Cylinders, Chests, etc.

PRICE LIST AND SAMPLE FREE.

U. S. MINERAL WOOL CO., 174 Washington St., NEW YORK.

BOURNE & KNOWLES MFG. CO., Cleveland, Ohio.

ROEBLING
RUBBER
WIRE

THE BABCOCK & WILCOX CO.
29 CORTLAND ST.
NEW YORK
CABLE ADDRESS
NEW YORK
"GLOVEBOXES"
ALL FOREIGN OFFICES
"BABCOCK"

STEAM
WATER TUBE BOILERS

SEND FOR OUR BOOK "STEAM"

BOSTON 8 OLIVER ST.
PHILADELPHIA 643 DREXEL BLDG.
SAN FRANCISCO 32 FIRST ST.
BRANCH OFFICES
CHICAGO 1215 MARQUETTE BLDG.
NEW ORLEANS 339 CARONDELET ST.
PITTSBURGH 1001 CARNEGIE BLDG.
ATLANTA, GA. 619 EQUITABLE BLDG.
CLEVELAND 817 SECURITY BLDG.
ST. LOUIS MO.
HAVANA, CUBA 31 CALLE DE LA AMARGURA.

FRINK'S REFLECTING SHADES

In Deep, Flat and Convex Shapes.

NONE BETTER CAN BE MADE.

They are lined with silvered corrugated, best mirror or opal glass, in sections, rigidly held in place by solid metal frames. They reflect all the light there is. Frink's silver-plated corrugated glass is the best known reflector and diffuser of light.

Book of Light, and Estimates Free.

I. P. FRINK, GEO. FRINK SPENCER, Manager.
551 Pearl Street, New York.

Weatherproof Wire.

COMPLETE STOCK CARRIED BY
WESTERN ELECTRIC CO., New York.
ELECTRIC APPLIANCE CO., Chicago.
PETTINGELL-ANDREWS CO., Boston.
ELECTRICAL ENGINEERING CO., Minneapolis.
ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis.
THE BRADFORD BELTING CO., Cincinnati.

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

Phillips Insulated Wire Co.,
Office and Factory, - PAWTUCKET, R. I.

PRICE $5.00

WARNER'S POCKET BATTERY GAUGE

Especially Recommended for Telephone Inspection

The ONLY convenient and practical instrument for the purpose. INDISPENSABLE to those using batteries. The size of an ordinary watch—easy to carry with you. CHEAPER GAUGES ARE NECESSARILY INFERIOR. Send cash with order; we prepay charges.

THE STANDARD ELECTRIC TIME CO.,
23 Jefferson Street. *WATERBURY, CONN.*

CAN WATER-WHEELS BE GOVERNED?

If you will give us a description of your water-wheels and how they are set, we can refer you to a plant similarly arranged, where our governors are in use. Our governors are now being used to regulate over

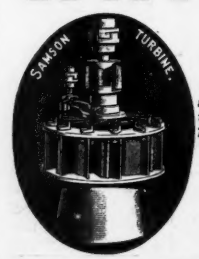
SEVENTY-FIVE THOUSAND HORSE-POWER

of water-wheels in this country alone. We sell our governors with a POSITIVE GUARANTEE that they will give a better speed regulation than any other make of governor.

LOMBARD WATER-WHEEL GOVERNOR CO.,
61 Hampshire Street (Roxbury District), BOSTON, MASS.

WATER WHEELS

For Heads of 3 Feet to 2000 Feet.
Especially adapted to all kinds of
ELECTRIC POWER AND LIGHTING PLANTS.



Recent tests at Holyoke, given below, enable us to guarantee: *The Largest Power ever obtained from a wheel of the same diameter. The highest speed ever obtained for the same power. The highest mean efficiency when running from half to full gate.* We guarantee also: *A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing.*

Test of a 45 in. SAMSON, Jan. 25, '97.						Test of a 35 inch SAMSON, Feb. 1, '97.					
Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.	Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03	Full	15.29	194.25	102.02	143.44	81.08
⅞	15.04	138.12	155.03	223.61	84.55	⅞	16.56	187.75	92.15	146.73	84.72
¾	15.11	127.67	133.24	191.06	83.68	¾	17.33	178.50	83.95	138.40	83.88
⅝	15.88	131.50	112.65	162.80	80.25	⅝	17.54	176.40	68.82	109.64	80.09
½	16.47	126.87	90.04	127.73	75.95	½	17.68	168.50	57.69	88.14	76.19

JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.